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Coastal and Hydraulics Laboratory

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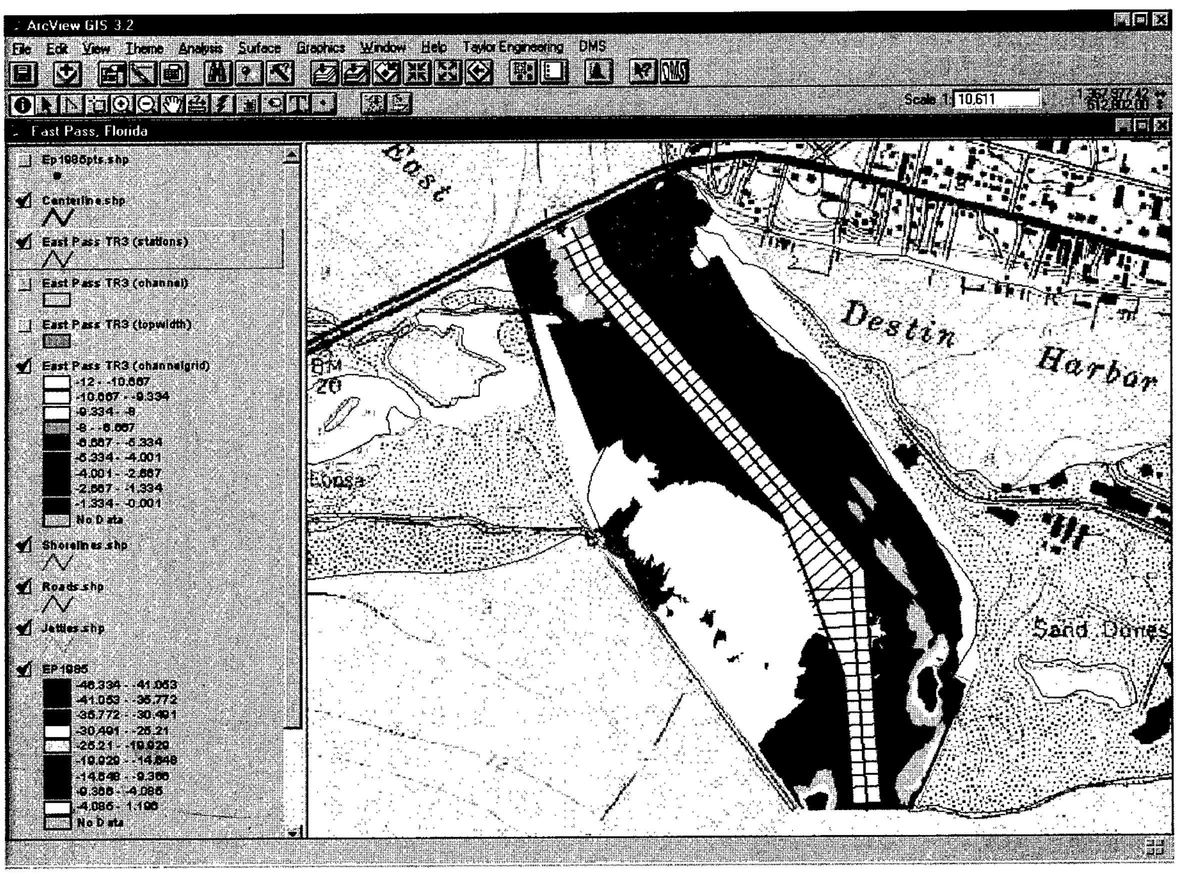
DMS: Diagnostic Modeling System

Report 3

DMS Data Manager — A User's Guide

Kenneth R. Craig, Mark S. Gosselin, Daryl S. Cook, and Thad C. Pratt

September 2001



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DMS: Diagnostic Modeling System
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DMS Data Manager — A User's Guide

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Contents

List of Figures

Preface

The study described in this report was performed under the Diagnostic Modeling System (DMS) Work Unit of the Coastal Sedimentation and Dredging Program administered by Headquarters, U.S. Army Corps of Engineers (HQUSACE). Research and Development activities of the DMS are being conducted at the U.S. Army Research and Development Center (ERDC) Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS. HQUSACE Program Monitors are Messrs. Charles B. Chesnutt, Barry W. Holliday, and Mike Klosterman.

Work was performed by Mr. Kenneth R. Craig and Dr. Mark S. Gosselin of Taylor Engineering, Inc., Jacksonville, FL, Mr. Daryl S. Cook of Dimco, Inc., and Mr. Thad C. Pratt of CHL. The contract monitor and principal investigator of the DMS work unit was Dr. Nicholas C. Kraus, Senior Scientists Group, CHL. Dr. Kraus provided direction for and technical review of this report.

Work at CHL was performed under the general supervision of Mr. Thomas W. Richardson, Acting Director, CHL.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

1 Diagnostic Modeling System Data Manager – Overview

This report documents the development, functionality, and application of the Diagnostic Modeling System (DMS) Data Manager, a Geographic Information Systems (GIS)-based software package to organize and examine dredging-related data. The Data Manager was developed as part of a joint demonstration project conducted by the U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), and Taylor Engineering, Inc. The DMS Data Manager forms one of three primary components of the DMS, and this report serves as a users guide.

Background

The DMS is being developed under the Coastal Sedimentation and Dredging Program administered by Headquarters, U.S. Army Corps of Engineers (USACE). The DMS is intended to provide the Corps with a rapid and inexpensive, yet reliable, capability to develop and evaluate navigation channel operations and maintenance (O&M) alternatives based on limited information on the hydrodynamic and sediment transport conditions at a site.

The DMS gives a rapid evaluation or diagnosis of a problem shoaling area and provides guidance for determining possible solutions. The economic lever underlying the DMS concept is that a low-level analysis, possibly supplemented by a modest numerical modeling effort, can yield substantial cost savings without interrupting ongoing O&M activities and schedule. That is, the DMS is intended to provide feasible alternatives for reducing O&M costs within the dredging cycle of the subject project. The application time and effort in applying the DMS are proportional to the maintenance time of the project.

This chapter begins by presenting an overview of the DMS methodology. Next, a description of the Data Manager development goals is presented, followed by hardware and software requirements to operate the system. The chapter concludes with the problem statement.

Diagnostic Modeling System – Overview

The DMS provides a quick and concise capability to identify, categorize, and evaluate navigation channel sediment deposition hot spots for correction. The

DMS incorporates established public domain coastal hydrodynamic models to be applied in combination with a suite of analytical tools and procedures. The concept was to develop a common sense-based methodology for treatment of shoaling problems. The tools included in the DMS help engineers identify problem areas of shoaling, characterize the causes of these problems, and develop practical, cost-effective solutions.

The DMS comprises three components. The DMS-Data Manager, a GIS-based computer program and primary subject of this report, allows the user to organize and view all the relevant information within a project area. Examples of the data kept in the DMS-Data Manager include digitized bathymetries, aerial photographs, GIS coverages, and shoaling history. This component gives "one-stop" access to all graphical and numerical information associated with a maintained channel. The DMS-Manual is a reference document containing diagrams and example photographs of different shoal categories. This field guide to shoaling problems helps identify the types of shoals by giving the user comparable examples. In addition to providing diagrams and examples, the DMS-Manual also provides descriptions of the shoal and the mechanisms that create it.

The DMS-Analytical Toolbox is a suite of analytical tools and recommendations for graphical formats for quick diagnosis of shoaling problems and investigation of possible solutions. This toolbox includes a collection of computer software (e.g., hydrodynamic models, wave refraction/diffraction models) and analytical models (e.g., sediment transport equations, wind generated wave models). In addition, the toolbox contains recommended output formats from the models. By standardizing output formats, mechanisms that contribute to shoaling will become easier to identify. In addition, the use of standardized output formats facilitates the building of an experience base with which to compare future shoaling investigations. Applied in parallel, these three components provide for rapid assessment of shoaling problems.

In addition, case studies are being performed to evaluate the DMS and exercise the tools being developed. The DMS technical reports by Gosselin, Craig, and Taylor (1999) and Kraus, Mark, and Sarruff (2000) discuss applications at East Pass, FL, and Matagorda Bay, TX, respectively.

DMS Data Manager

Early on in the DMS development process, the DMS work unit identified a need for an organized and cohesive approach to data management. With more and more project data delivered and maintained in digital format, the work unit logically proceeded to specify a software package to synthesize all data necessary to apply DMS concepts to a project. These data are inherently geographic in nature, leading to a GIS-based approach.

GIS software allows multiple layers of geographically referenced data to be viewed and analyzed. In its simplest implementation, a GIS provides a means to link the graphical representations of data (e.g., roads, channels, bathymetry) to an informational database specific to the location of interest. The graphical representations are known as features, while data in the database are attributes and records (Figure 1). Features can take the form of points, lines, or polygons.

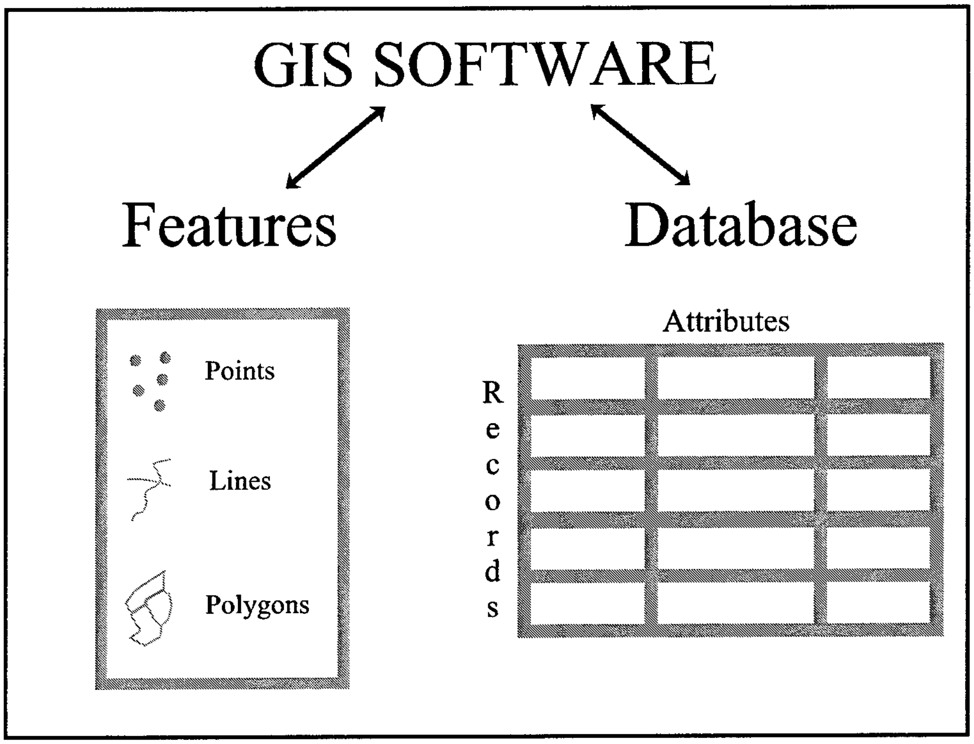


Figure 1. Relationship between GIS software, geographic features, and databases

Linking back to the attribute information in the database allows a point to be recognized as a fire hydrant, or a channel marker, for instance. Specifying how the point displays on screen can further enhance the relationship of the feature to what it represents. Carrying the channel marker example further, specific markers can be displayed as red squares or green triangles to indicate which side of the channel they define.

The Data Manager is a customized extension of the commercially available GIS software package ArcView from Environmental Systems Research Institute (ESRI), Redlands, CA. ArcView is widely distributed throughout the industry as a powerful data viewer. Additionally, ArcView has substantial analysis capabilities as well as its own scripting language that allows customized functionality to be incorporated in projects.

The DMS research work unit assumed the user to be familiar with computer software but only minimally experienced with GIS systems. As such, development focused on simplifying the project setup and analysis phases. In general, efforts have been made to reduce the amount of data manipulation outside of the Data Manager to create comprehensive projects. The Data Manager provides step-by-step procedures that prompt the user for necessary data to develop comprehensive project databases. Additionally, the Data Manager incorporates several custom analysis tools to perform simple volumetric comparisons and cross-section analyses.

Report generation and data maintenance were also foci of the Data Manager development. Included with the Data Manager, the Dredging Record Center (DRC) allows users to document past and current dredging operations in a

Microsoft Access relational database. Users can produce consistently formatted reports from these data via the reporting option available in the Data Manager. This capability allows examination of past dredging records in a tabular and/or graphical format to aid in analysis and review of shoaling problems. Examples of such reports include station, area, and project summary reports that include details and summary statistics (e.g., total volumes, annual volumes) for user-defined areas.

The Data Manager also communicates with the Hydraulic Processes Analysis System (HyPAS) as described by (Pratt and Cook 2000), another ArcView extension developed to analyze a wide variety of data types generated by field measurements or in numerical modeling. The two packages communicate efficiently and provide data to each other for their respective applications. The combination of the two packages provides a set of powerful analysis tools to examine, in detail, data from Federal navigation projects.

Hardware Requirements

Basic hardware requirements to operate the DMS Data Manager parallel those for the ArcView software package. Industry practice generally dictates defining both the minimum and recommended configurations. Obviously, the recommended configuration produces much better performance. The minimum hardware specifications for the DMS Data Manager are as follows:

a. Industry-standard personal computer with at least a 90 mhg equivalent or higher microprocessor and hard disk.

b. Memory: 32 MB.

The recommended configuration includes the following:

a. Industry-standard personal computer with at least a 200 mhg equivalent or higher microprocessor and hard disk.

b. Memory: 64 MB.

c. OpenGL accelerated graphics card with geometry co-processor and 8Mb + graphics/texture memory (also known as "local memory").

Hardcopies of Data Manager output can be printed on any standard Windows printer. Access to color-enabled printers helps to clarify report data as well as accurately document map development.

Software Requirements

The DMS Data Manager was developed for the Windows NT 4.0 operating system in conjunction with the latest release of ArcView (Version 3.2) — extending the base functionality of the ArcView environment (Figure 2). Although support of other operating systems is not planned at this time, internal operating system calls contained in the software should be applicable to the other members of Microsoft's operating system family (Windows 95/98/2000). The Data Manager extension incorporates ESRI's 3-D Analyst extension to develop and view bathymetric surfaces and to calculate sediment volumes. The 3-D

Analyst, while not necessary to view much of the base map data, provides a vital element to the software. The CAD Viewer extension, provided with the base ArcView package, allows incorporation of CAD drawings in AutoCad (.dwg), AutoCad export (.dxf) and MicroStation (.dgn) formats within the database. Additionally, the latest version of the software supports many common image formats (.jpg, .tif, .sid, etc.), allowing easy viewing of existing and historic site conditions. Finally, the Data Manager uses the Crystal Reports for ArcView application to generate reports. Crystal Reports is included in the base ArcView package.

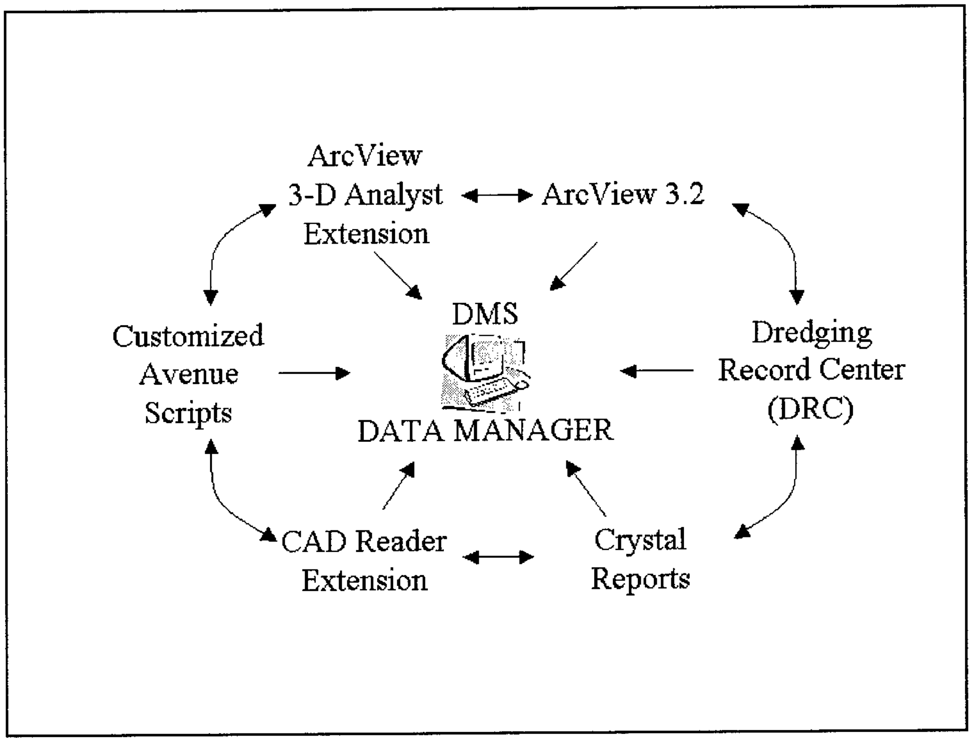


Figure 2. DMS Data Manager software components

Data Requirements

The Data Manager supports a wide variety of data formats, including Arc/Info coverages, shapefiles (ArcView's native format), AutoCad drawings (through AutoCad 2000), MicroStation files, Dbase databases, various text-based data files, and digital images. The initial step required during development of the database is selection of a common coordinate system (typically State Plane or UTM), datum (NAD27 or NAD83), and units (feet, meters, decimal degrees) to be applied to all the data. A common coordinate system provides a common reference for the Data Manager and allows accurate data layering. The required data fall into four classifications: base map information, bathymetric surveys, dredging records, and miscellaneous. Digital photographs and hydraulic data can be incorporated with the addition of the HyPAS extension. Each classification is discussed in more detail in the following sections.

Base map

Base map information can be anything the user associates readily with the project area. Examples include project (channel) boundaries, aids to navigation, shoreline positions, shore protection structures, marina and port facilities, sensitive environmental areas, deposition areas, hazardous areas, shipwrecks, fish havens, reefs, utilities, buildings, roads, and bridges. Typical formats for base map data will include Arc/Info coverages, shapefiles, or one of the CAD formats. The World Wide Web and in-house GIS personnel provide numerous sources for base map data from various Federal, state, and local government agencies.

ASCII text files

Several Data Manager tools require formatted ASCII files. These include coordinates defining channel center lines, and stationing information. These data are often maintained on in-house spreadsheets or databases that can be exported to the appropriate format. Alternatively, the user can create the files in any standard word processing program.

Bathymetric surveys

The Data Manager interpolates standard hydrographic survey data on to grids representing the bathymetry in and around the project area. These data will typically be available in ASCII text files (X, Y, Z) or CAD drawings. A survey conversion tool leads the user step by step through the surface generation process and collects additional supporting information on each survey.

Dredging records

Historical dredging records can be maintained in the Dredging Record Center, a Microsoft Access database that communicates transparently with the Data Manager. Data are accessed with standard queries through a wizard interface. Data input forms translate data to a standardized format. Typical records include date, contractor, location (e.g., station or river mile), horizontal dimensions, depth of cut, design and pay volumes, disposal location, and dredge specifications. Typically, preparation of this portion of the database will require manual input of printed data.

One of the primary advantages to a GIS-based approach is derived from the geographic relationships inherent in the data. Dredging records, for example, document project performance at a location and thus have a geographic component. Therefore, the data can be referenced to coordinates indicating that location (i.e., stationing). These data can then be selected for analysis based initially on the location. Specific problem areas can be isolated and examined to determine trends not readily discernible through standard tabulated data. Several reports can be generated based on these records.

Digital photographs

The HyPAS software provides a means to include digital photography to document general and specific changes to a system over time. These photographs can include aerials, oblique ground level shots of specific locations, documentary evidence of projects – essentially any aspect of the project that will benefit from photographic evidence. A scanner can convert conventional photographs to digital format for incorporation in the database. Typically, digital images should be converted to JPEG format at a standard resolution of 640 x 480 pixels through third party software packages. HyPAS includes options to document the source, date, and description of the photograph. The user may easily view the images with a single mouse click, select and print those of special interest, and incorporate these images in various reports. Georeferenced aerial photography (i.e., stretched to match the adopted coordinate system) can be incorporated as an additional theme in the project base map.

Miscellaneous

Any additional relevant data fall under the miscellaneous classification. This category can include sediment grain size curves, tabulated sediment data, a tidal record time series, datum corrections, and sea level rise rates based upon survey epoch. In a manner similar to that used to maintain the dredge records, the end user incorporates these data into an ArcView database where they become readily viewable and searchable.

Problem Statement

The Corps maintains thousands of miles of navigation channels throughout the coastal and inland waters of the United States and its territories. These Federally maintained channels comprise the maritime heart of the nation's waterborne commerce and national defense. As such, their maintenance commands a major share of the Corps O&M budget every year. With the continual ebb and flood of the tide, sediments enter and deposit in these channels, often in areas neither welcomed nor anticipated. Excessive deposition reduces channel depths which leads to navigational hazards that require frequent and expensive dredging.

The factors lead to the creation of the DMS work unit. Early in the development process, the work unit identified a need for a software package to organize and provide access to relevant navigation project data in a central repository. The DMS Data Manager seeks to address this need.

This report discusses, in detail, data requirements and functionality of the Data Manager. Chapter 1 gives a background of the DMS methodology, introduces the Data Manger, and presents the problem statement. Chapter 2 details the functionality of the Data Manager tools used to develop baseline project information. Chapter 3 outlines the Data Manager tools used to analyze relevant project data. Chapter 4 documents an example application of the Data Manager to East Pass, FL. Chapter 5 presents conclusions and recommendations.

2 Components: Project Setup Tools

Introduction

Seven custom tools comprise the DMS Data Manager extension to ArcView. These tools can be categorized as either project setup tools or data analysis tools. The setup tools include the *Getting Started* screen, the *Setup Wizard*, the *Stationing Tool*, and the *Survey Conversion Tool*. Each of these addresses a different aspect of project creation. The end product is a well organized, comprehensive, and expandable data set that may be examined with the analysis tools. The four project setup tools are discussed in the following paragraphs.

Within ArcView, the Data Manager tools can be accessed either through the DMS menu item in the current view or the DMS toolbar (Figure 3). The DMS toolbar can be opened by clicking on the DMS button.

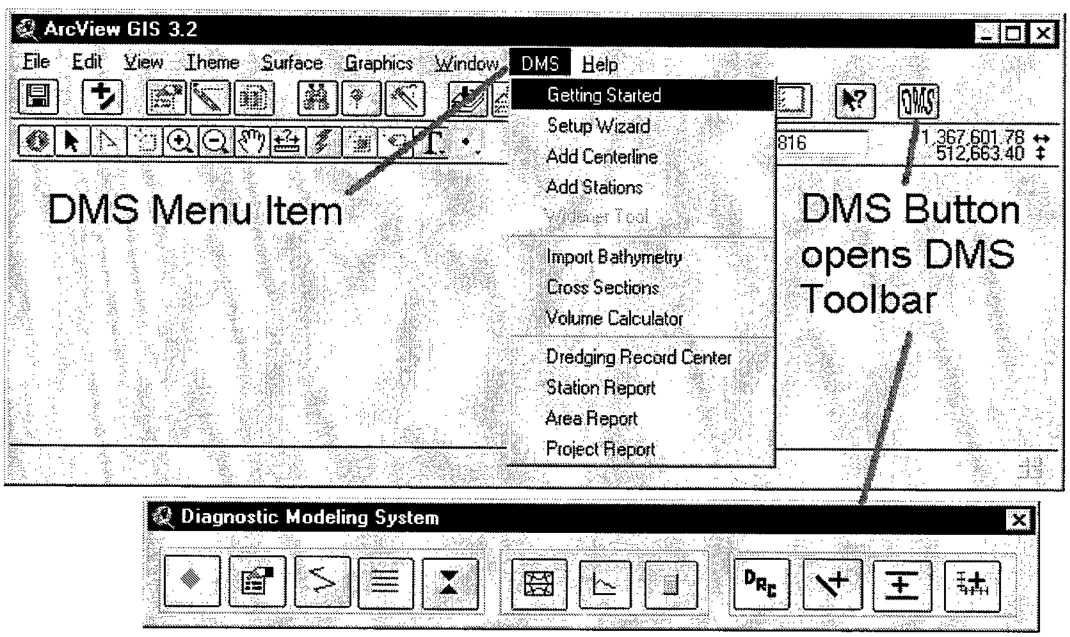
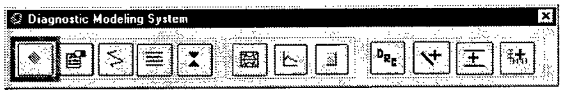


Figure 3. Data Manager tool access through the menu system or DMS toolbar

Getting Started Screen



The DMS *Getting Started* screen contains generic information pertaining to the required data types necessary to operate the DMS Data Manager (Figure 4).

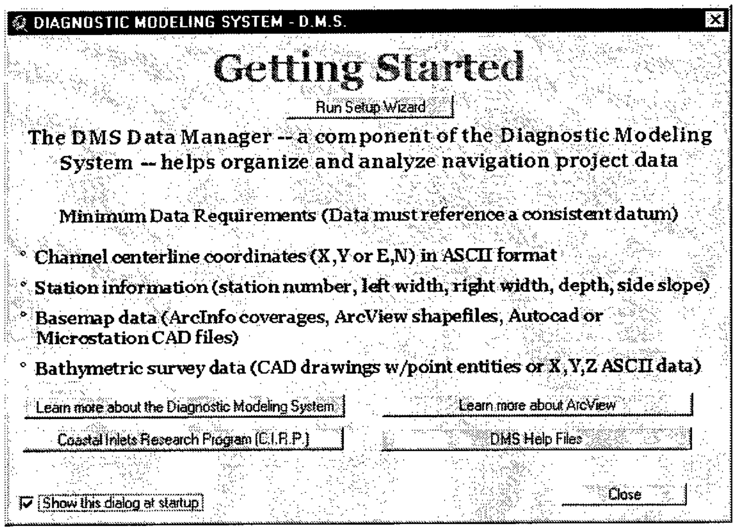


Figure 4. DMS Data Manager's *Getting Started* tool

Enabling/disabling the *Getting Started* screen

By default, the *Getting Started* screen displays each time the extension loads. This screen may be bypassed by clearing the checkbox in the lower left corner of the screen. Once the checkbox is cleared, the *Getting Started* screen can be reactivated by selecting the DMS *Getting Started* option from the view menu system.

Links

The *Getting Started* screen provides links to several areas outside of the Data Manager. Internet links to the DMS project Web site (*http://www.taylorengineering.com/ dmshome/dmsdefault.htm*) and the USACE Coastal Inlets Research Program (CIRP) Web site (*http://cirp.wes.army.mil/cirp/cirp.html*) are located near the bottom left of the screen (Figure 5). Clicking either button will open the default system Web browser and call the appropriate Web page.

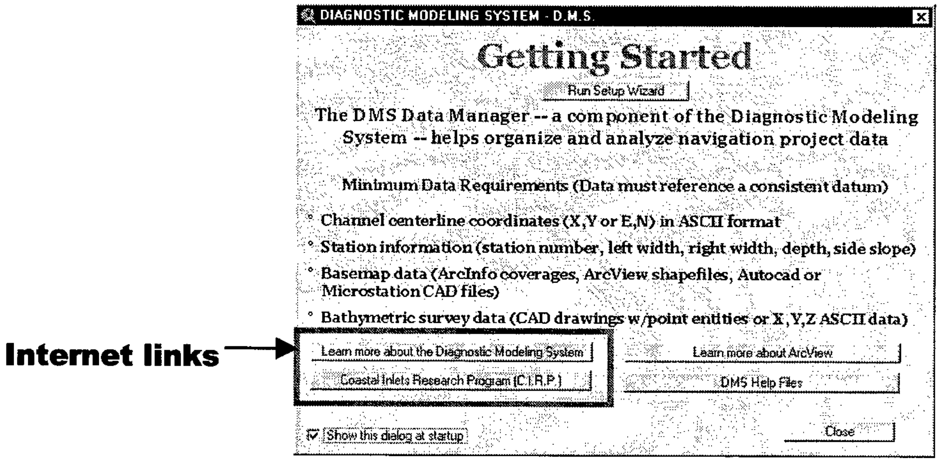


Figure 5. Internet links on the *Getting Started* screen

In addition, links to help system files can be found on the bottom right side of the screen (Figure 6). These access the ArcView help file system and the Data Manager help files.

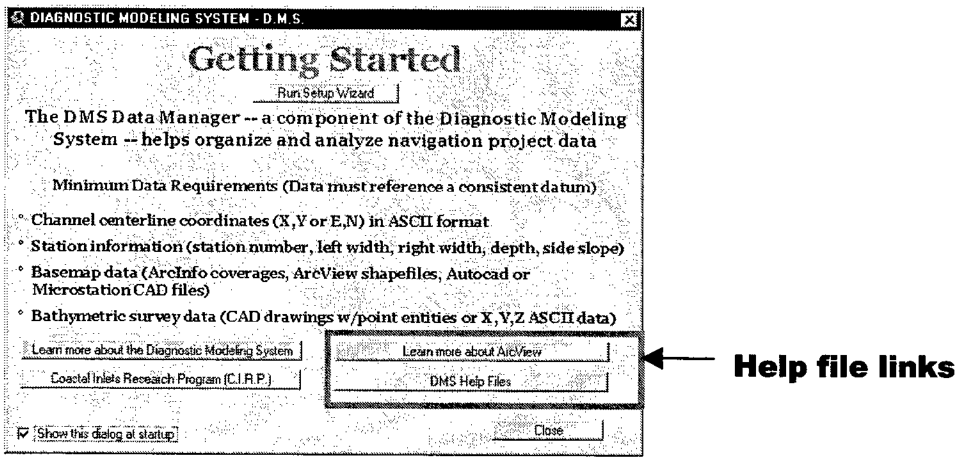


Figure 6. Help file links on the *Getting Started* screen

Finally, clicking the button at the top center of the screen leads directly to the next step in the process, the *Setup Wizard* (Figure 7).

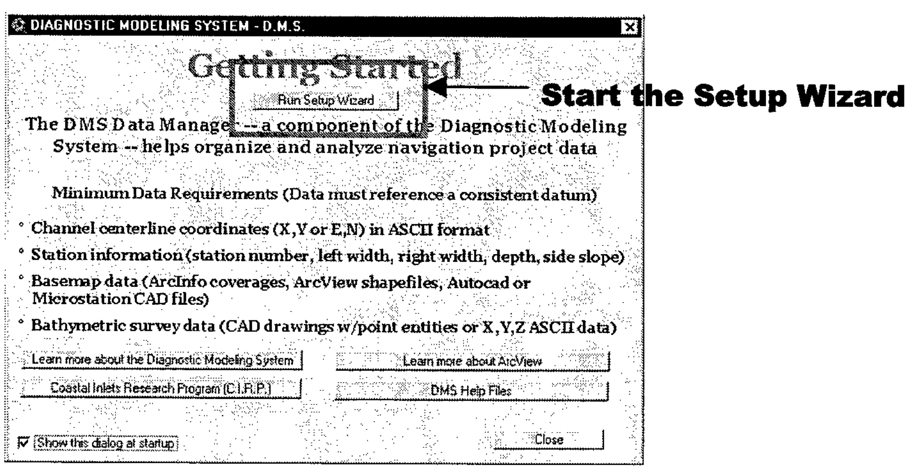
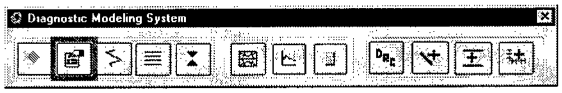


Figure 7. *Setup Wizard* link on the *Getting Started* screen

Setup Wizard



The *Setup Wizard* walks the user through the process of creating a Data Manager project file by displaying a series of screens that prompt the user for general project information.

Step 1: Introductory screen

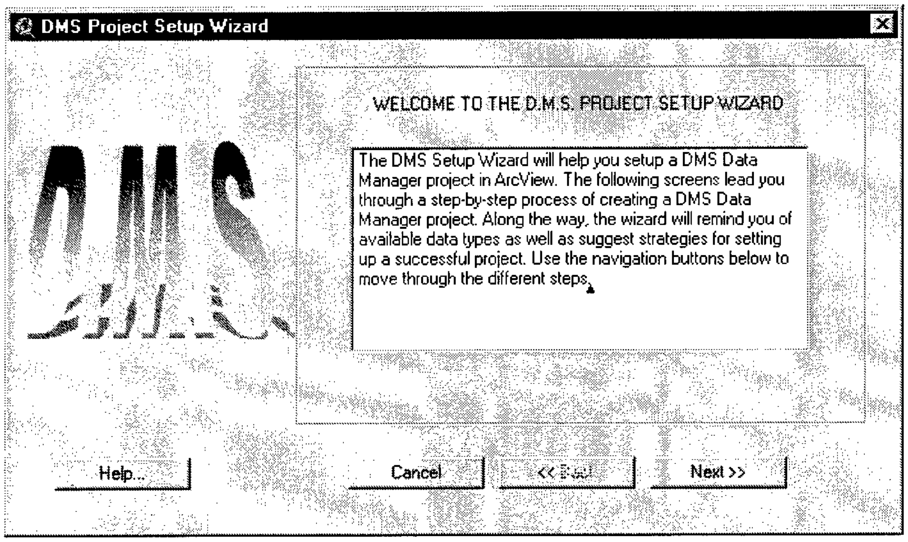


Figure 8. *Setup Wizard*: Opening screen

The first screen offers a simple welcome and introduces the user to the data requirements that follow (Figure 8). Navigation buttons at the bottom of the screen guide the user through the following steps. Users may abort the operation at any time by clicking on the cancel button.

Step 2: Select a view

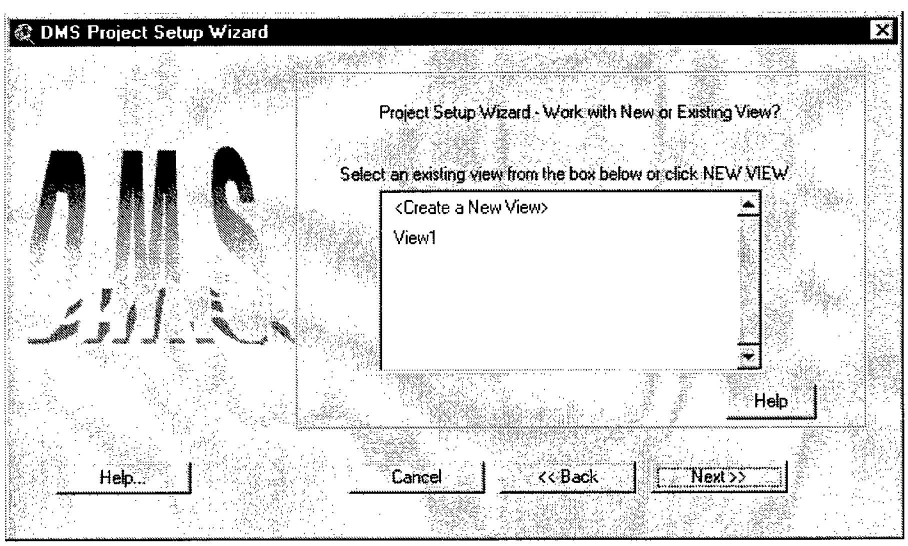


Figure 9. *Setup Wizard*: Select view screen

Step 2 presents users with a list of existing views in the current ArcView project file (Figure 9). Users are prompted to select either one of these existing views or to create a new view to work with in subsequent steps. If the user wishes to *Create a New View*, a new view will be created and named in the following step.

Step 3: Define project parameters

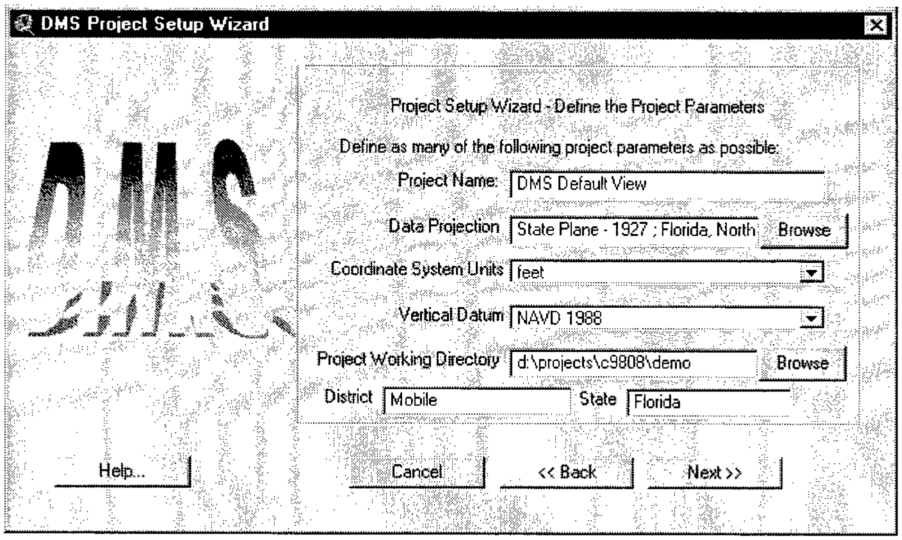


Figure 10. *Setup Wizard*: Project parameter screen

Step 3 prompts for general project parameters (Figure 10). The user may set the name of the current view through the *Project Name* field. Typically this title will reference the Federal project or channel name.

Users may select the data projection from a standard list maintained within ArcView. This list is displayed by clicking the *Browse* button (Figure 11). Examples of typical data projections used include state plane coordinates, Universal Transverse Mercator (UTM), or geographic coordinates (latitude/longitude).

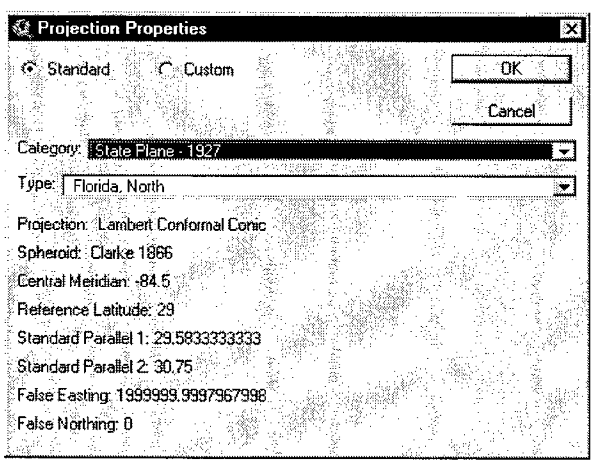


Figure 11. Project selection dialog

Next, the coordinate system units are selected from the drop-down box. Options include feet, meters, or decimal degrees.

The vertical datum for all elevation data can be selected from the next drop-down box. Users may select from either the Nation Geodetic Vertical Datum of 1927 (NGVD 1927) or the North American Vertical Datum of 1988 (NAVD 1988).

In the next box, users can select the project working directory by either typing manually or browsing the existing directory structure through the *Browse* button. The project working directory becomes the default directory where all new data are stored. This helps users maintain project data in an organized fashion.

Finally, users may define both the Corps District working on the project as well as the state where the project is located.

Step 4: Add data to view

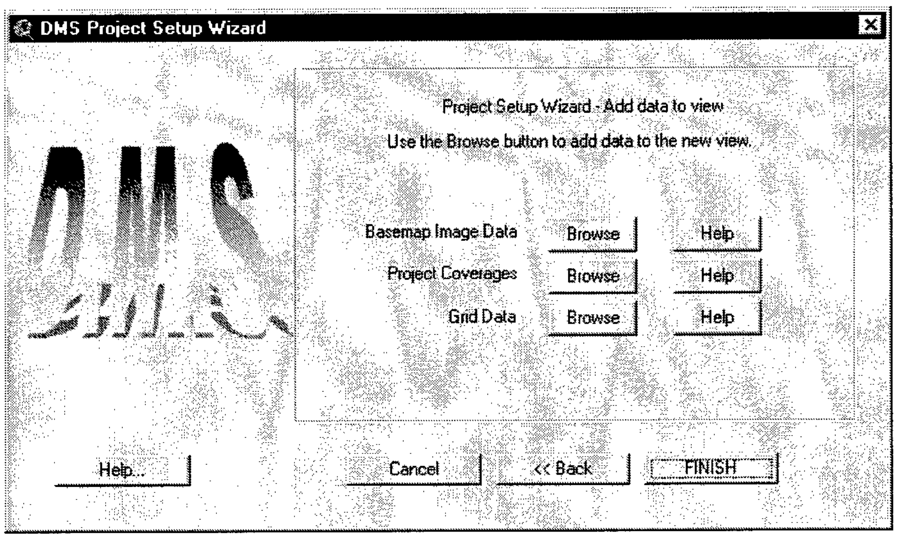


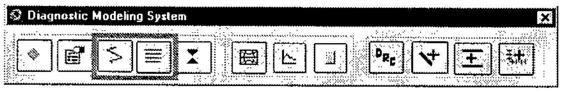
Figure 12. *Setup Wizard*: Add data screen

The final screen prompts the user to locate base map data files in the various formats read by ArcView (Figure 12). The major data classifications are listed in the order that they are usually added to a project. Although data layering is an important consideration, the order that data are selected is not critical at this point. Users can reorder layers from within the view at a later time. Typically, an aerial image that has been georeferenced to the data projection defined earlier will serve as the foundation of the base map information. On top of this image, users can layer any type of additional base map information, for example, as roads, bridges, buildings. These data, accessible through the *Browse* button adjacent to *Project Coverages*, can be in Arc/Info coverage format, ArcView shapefiles, or CAD drawing files. Users also have the option to import existing grid data that have been developed in previous Data Manager sessions.

Any files accessible from the user's computer can be incorporated into the project. Networked computers facilitate this type of remote data exchange; data need not reside locally on a user's own workstation to be incorporated in the Data Manager project. A data report can be produced which will list the paths to all data referenced in the project.

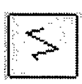
After the *Setup Wizard* completes processing data, the user is presented a dialog box asking whether to continue to the next step, the *Stationing Tool.*

Stationing Tool



The *Stationing Tool* produces a graphical collection of stations, usually every 30.48 m (100 ft), along the navigation channel's center line. These stations contain channel template information used later to pull cross sections from survey data and to perform volume calculations during project design.

The *Stationing Tool* performs several complementary tasks. First, the tool creates a channel center line defined by the user in a formatted ASCII file. The tool reads this file and constructs the center line in the currently active view. The coordinates must match the coordinate system previously defined in the *Setup Wizard.* Next, the *Stationing Tool* creates channel stations, or cross-section lines, at regular or user-defined intervals along the channel center line. The tool creates two polygon shaped files representing the channel bottom and the top width of the channel projected up to the vertical datum. Finally, the tool transforms these polygons into an ArcView grid of the channel template. The grid can then be used with the analysis tools discussed in the next chapter.



Step 1: Select center-line coordinate file

The first step of the *Stationing Tool* involves selecting an ASCII file containing coordinates at the turning points of the channel center line (Figure 13). A dialog box opens to the project working directory and asks the user to select the file containing the center-line coordinates.

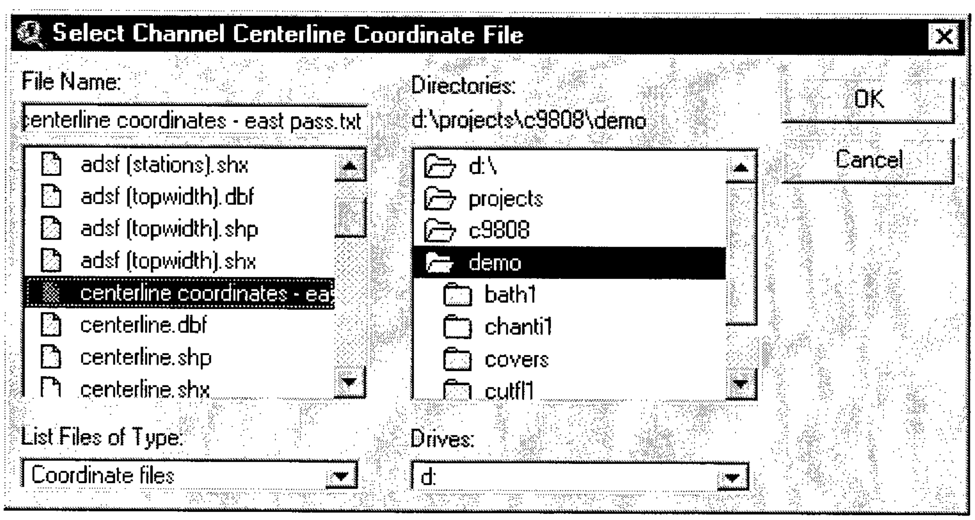


Figure 13. Center-line coordinate file dialog

Next, the user is asked to define the channel name (Figure 14). The name will be included as an attribute to the center-line theme.

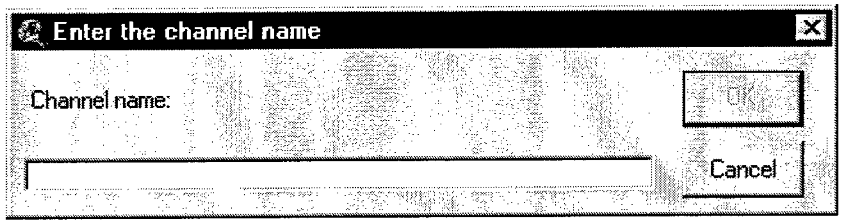


Figure 14. Define channel name dialog

This tool opens the selected ASCII file and reads the first five lines. The import dialog displays these lines and provides several options to define the file's format (Figure 15). The user can define the order of the data, whether a header line exists in the file, and the delimiter used to separate values.

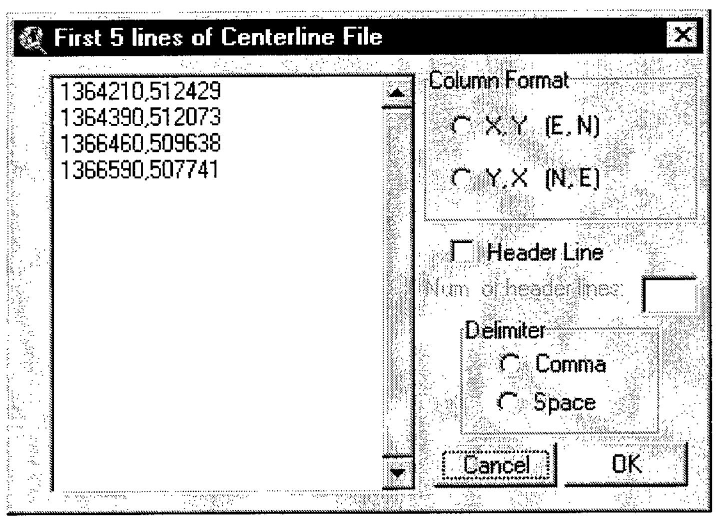


Figure 15. Center-line file format dialog

Step 2: Station definitions

After the center line is created, the tool asks whether the user wishes to create stations along the center line. If accepted, the station definitions dialog opens (Figure 16).

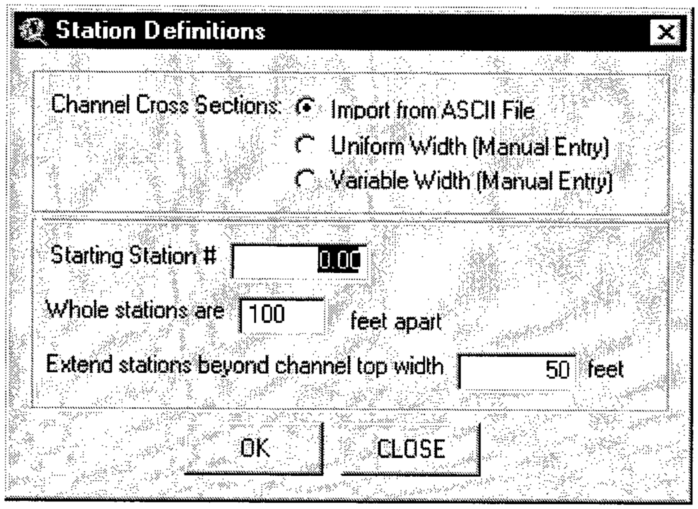


Figure 16. Station definitions dialog

The dialog provides three methods for creating stations along the center line:

a. Select an ASCII file containing channel template data.

b. Create uniform channel cross sections at each whole station along the entire center line.

c. Enter cross-section data at each individual station along the center line.

The user can define the starting station number as well as the distance between whole stations (typically 30.48 m (100 ft) or 304.8 m (1,000 ft)). Additionally, the user can define the distance to extend the stationing line beyond the channel template. This option allows the *Station Profile Display* tool to display adjacent bathymetry.

ASCII file option. If the user selects the ASCII file option, the tool opens the file, reads the first five lines, and displays the results in a dialog box (Figure 17). The file should be formatted with the following:

a. Station number.

b. Width of the channel to the left of the center line.

c. Width of the channel to the right of the center line.

d. Authorized depth of the channel.

e. Assumed side slope of the channel cross-section template.

All data for a station should be contained on a single line of the ASCII file and separated by a comma. A header line is optional.

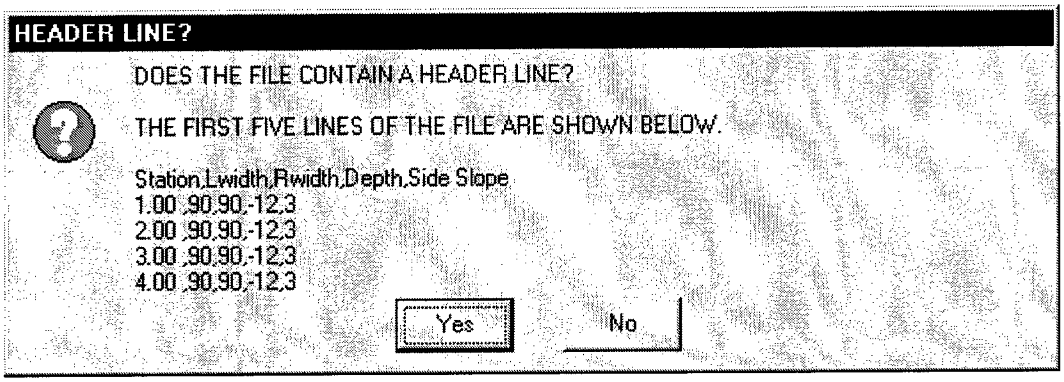


Figure 17. Station file format dialog

Uniform cross-section option. If the user selects the uniform cross-section option, the following dialog (Figure 18) prompts the user to define the cross-section parameters that will be used throughout the channel. The two bottom widths define skewed channels. The orientation is always from the lower station number to the higher station number. This can be thought of as looking downstream. The depth should be a negative number and correspond to the local authorized project depth. The side slope is an assumed value used in the channel cross-section template (e.g., 3H:1V).

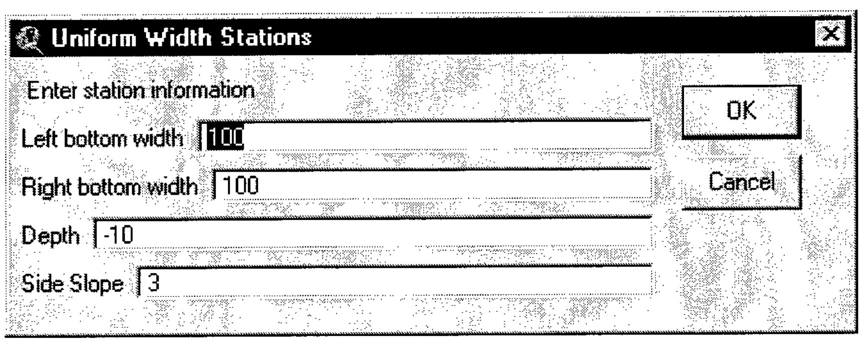


Figure 18. Uniform station dialog

Variable cross-section option. If the user selects the variable cross-section option, the tool displays a series of dialogs similar to the uniform cross-section dialog (Figure 19). Each instance of the dialog applies to the station noted in the title bar of the dialog. The fields apply as previously discussed. To facilitate data entry, any changes made to the dialog are preserved as defaults for the next instance of the dialog. Therefore, several identical cross sections can be entered quickly by simply accepting the default values.

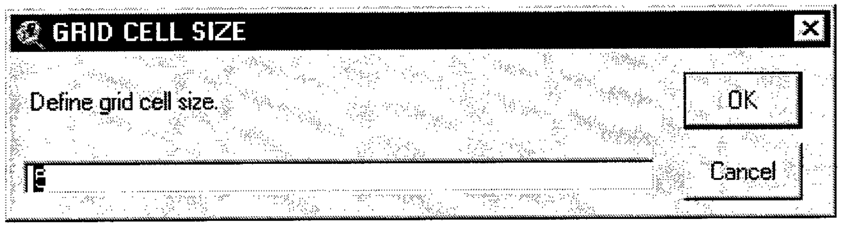


Figure 22. Grid cell size dialog

The end result is a grid of the channel template, based on the given geometry, to be used with the subsequent analysis tools. The user is cautioned not to delete any of the newly created themes (Figure 23).

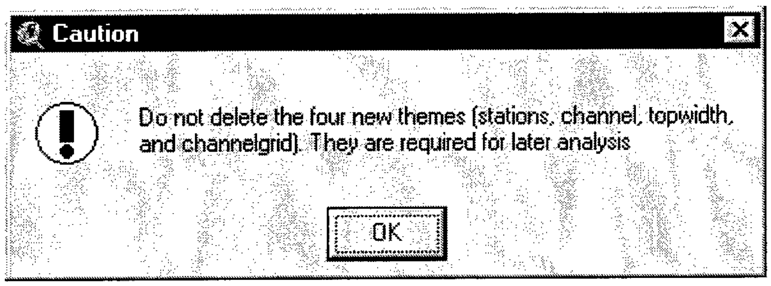
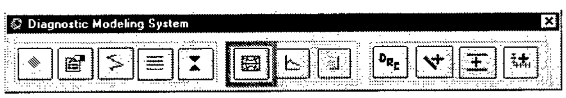


Figure 23. User caution dialog

Survey Conversion Tool



The *Survey Conversion Tool* takes hydrographic survey data and produces a grid representing the underlying bathymetry. Many survey types can be processed with the *Survey Conversion Tool* including condition surveys, pre- or post-dredging surveys, center-line surveys, and LIDAR/SHOALS surveys. The resulting bathymetric grid is analyzed later with the *Station Profile Display* and *Volume Calculator* analysis tools.

The initial dialog presents the data format options available to users (Figure 24). These include several ASCII formats, previously created ArcView TINs and Grids, and 3-D CAD files in DXF format. Each of these options are discussed in the following paragraphs.

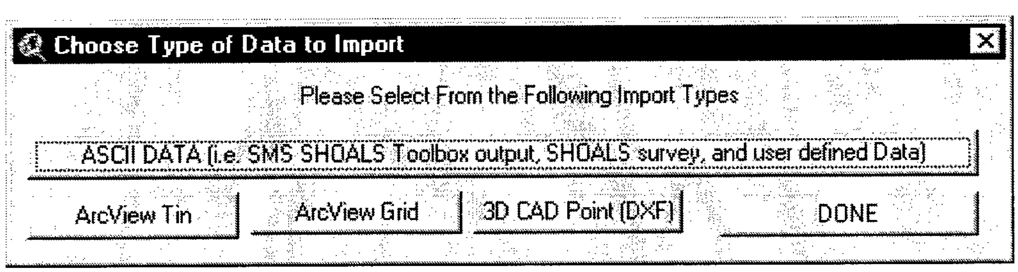


Figure 24. Import data format options dialog

ASCII data import options

Three forms of ASCII data may be imported into the Data Manager. These are generic ASCII formats containing X, Y, Z data, output files directly from a SHOALS survey, and bathymetric output from the Surface-Water Modeling System (SMS) (Figure 25).

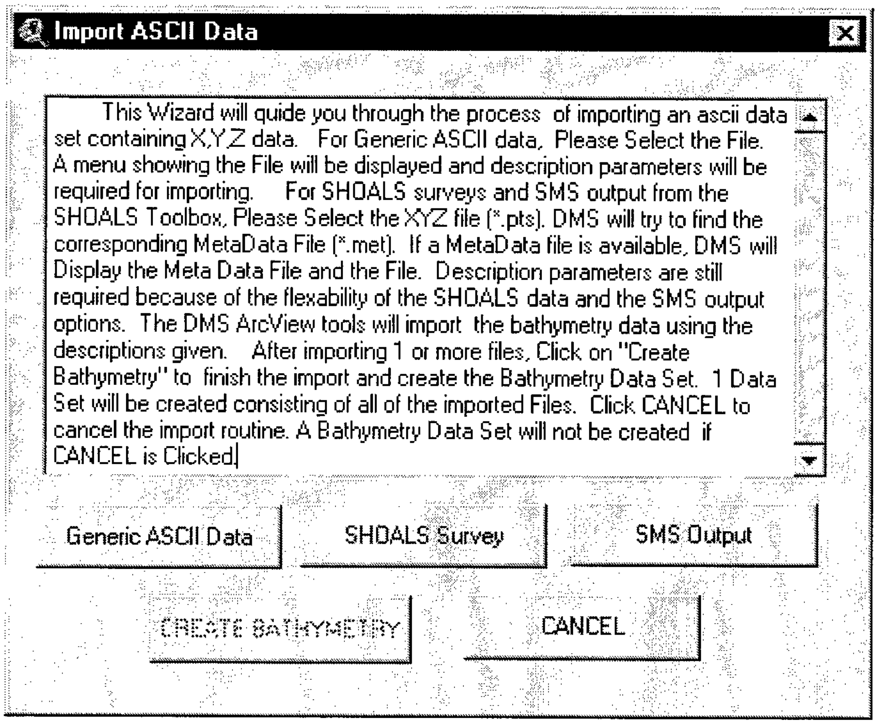


Figure 25. *Import ASCII Data* options dialog

SMS output files. Bathymetric point data can be exported from the SMS software package. Such files can be imported directly into the Data Manager (Figure 26).

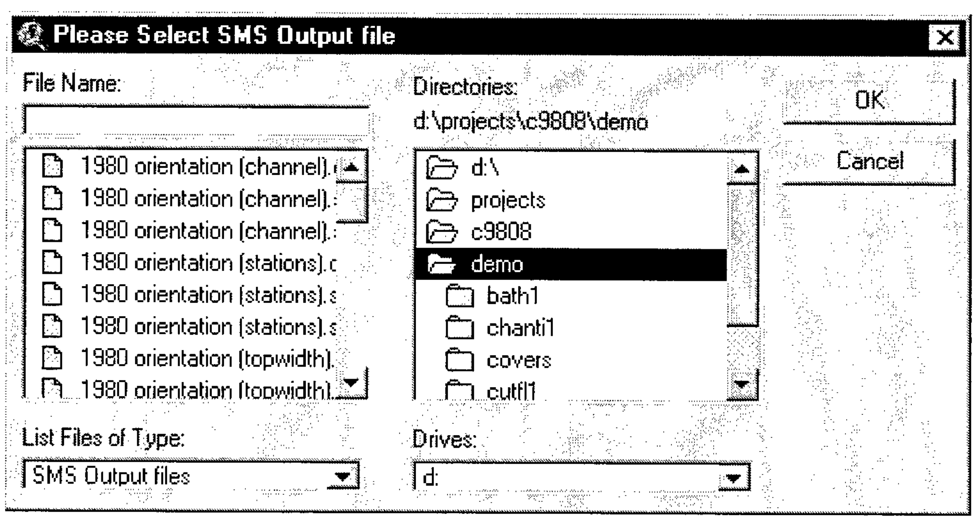


Figure 26. Select SMS output file dialog

SHOALS survey files. High-density bathymetric data acquired with the SHOALS/LIDAR system can be directly imported into the Data Manager (Figure 27).

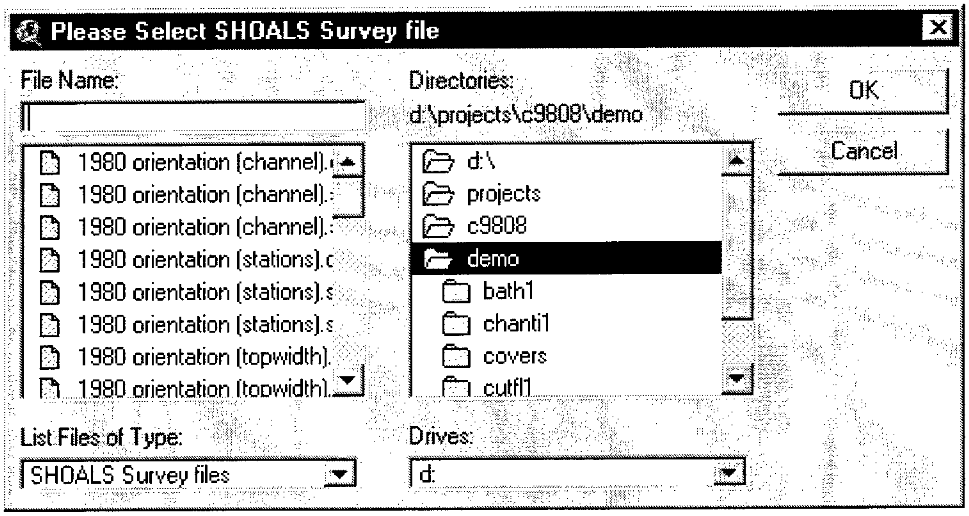


Figure 27. Select SHOALS file dialog

Generic ASCII format files. Any ASCII file containing generic X, Y, Z point data can be imported into the Data Manager (Figure 28).

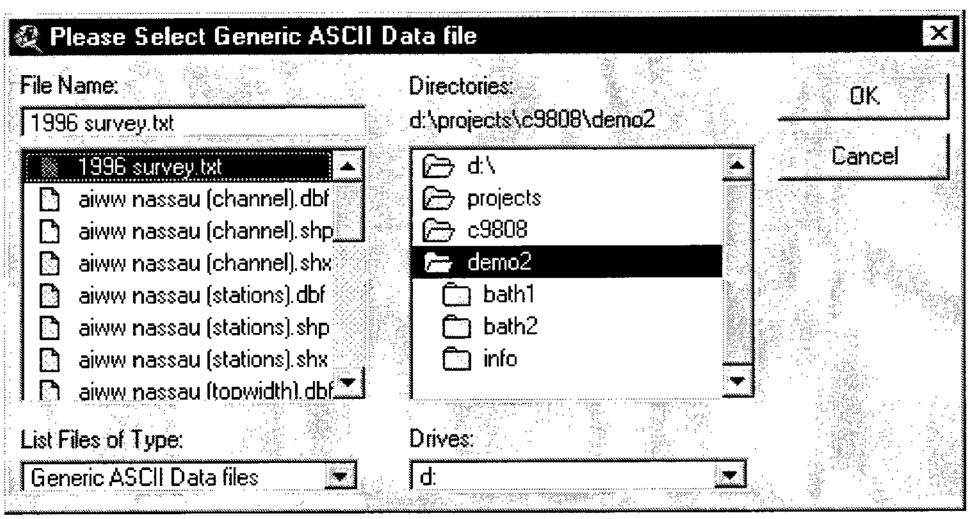


Figure 28. Select generic ASCII file dialog

Import format dialog. After the user selects a file to import, the tool opens a dialog that helps determine the underlying structure of the data (Figure 29). Raw data lines are displayed in the window on the left side. If a metadata file can be located for the file, this information is displayed below the raw data. The right side of the dialog allows the user to define the file format. Users may note the number of header lines, the type of data delimiter, and the columns containing the X, Y, and Z values in the raw data. When complete, the user should click on the *Import The File* button to begin the import process.

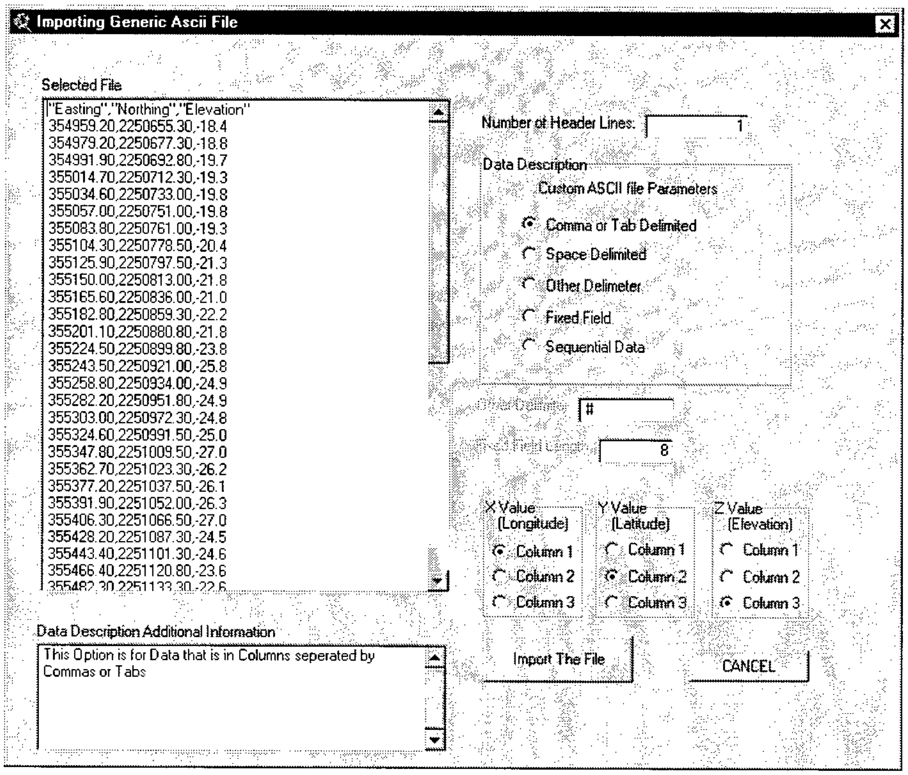


Figure 29. Generic ASCII file format dialog

When the file has been imported into the Data Manager, the user may then create a theme from these data. Note that the *Create Bathymetry* button is now enabled on the *Import ASCII Data* dialog (Figure 30). Clicking this button begins the computationally intensive process of creating a bathymetric grid from the data.

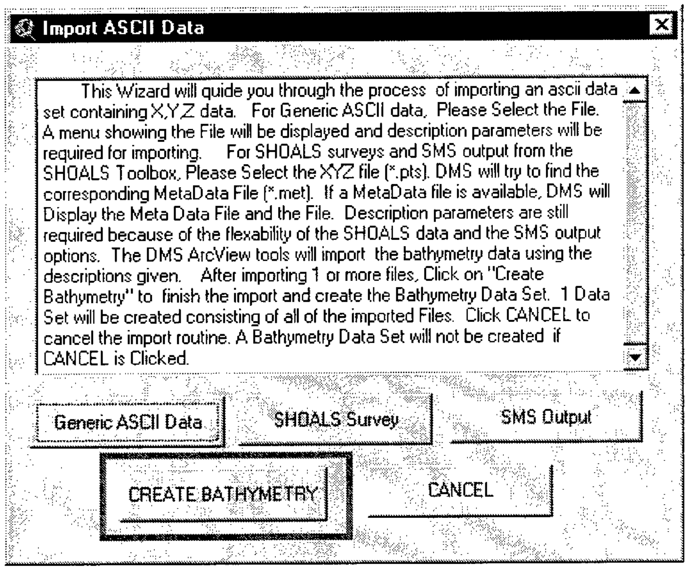


Figure 30. *Import ASCII Data* options dialog with *Create Bathymetry* button enabled

The user can create up to two themes from the data. First a gridded surface of the actual bathymetric data can be defined. Users may set the name in the dialog box (Figure 31). The user can also create a point theme from the data. Again, the theme name can be defined in the dialog box.

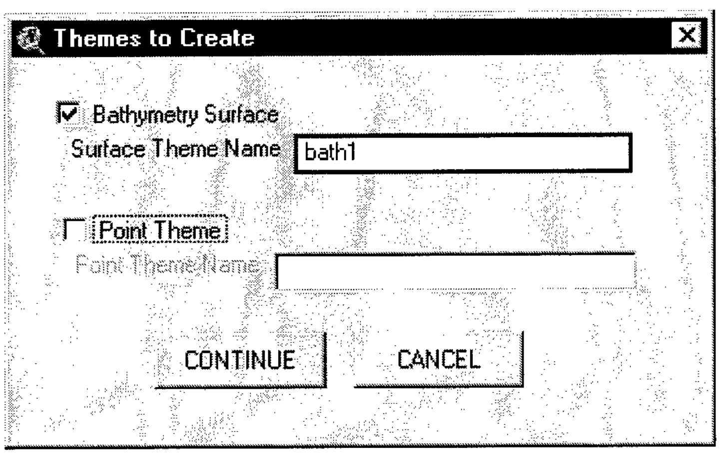


Figure 31. Create themes dialog

The final step in the ASCII data conversion defines the cell size and extent of the resulting grid. Select the appropriate values from the drop-down boxes in the dialog (Figure 32).

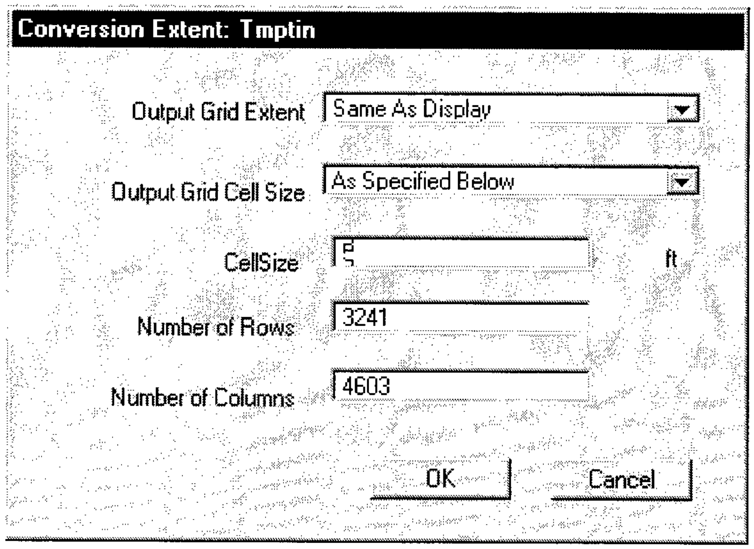


Figure 32. Grid definition dialog

ArcView TIN import option

Beyond assembling simple X, Y, Z point data, users can incorporate previously created ArcView TINS in the Data Manager. Selecting the *ArcView Tin* button (Figure 33) on the Data Import dialog opens a file dialog box (Figure 34).

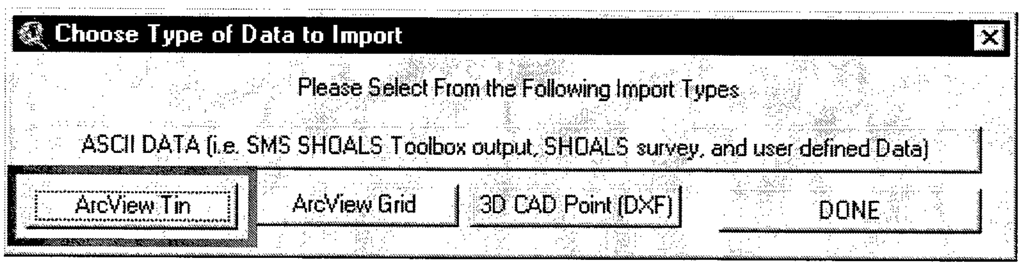


Figure 33. Import data format options dialog: *ArcView TIN* option

From here, the user can browse and select any available TIN data. Once selected, the TIN will be added to the current view and available for examination with the analysis tools discussed in Chapter 3.

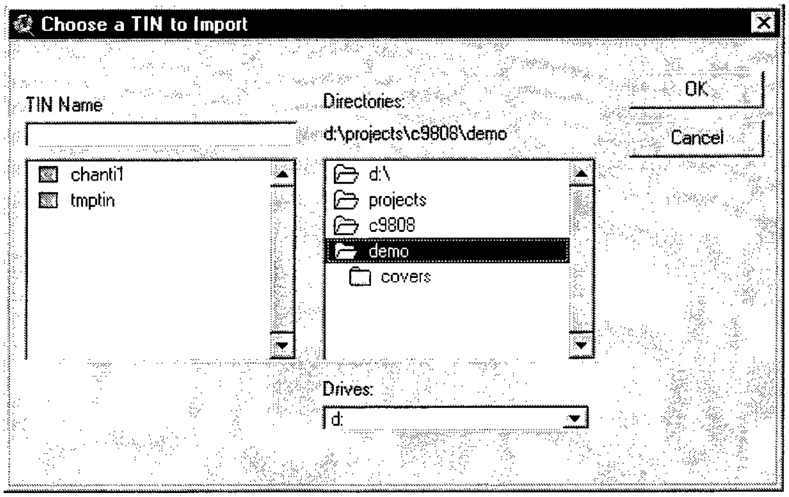


Figure 34. Import TIN file dialog

ArcView Grid import option

Users also have the option to incorporate previously created ArcView GRIDS in the Data Manager. Selecting the *ArcView Grid* button (Figure 35) on the Data Import dialog opens a file dialog box (Figure 36).

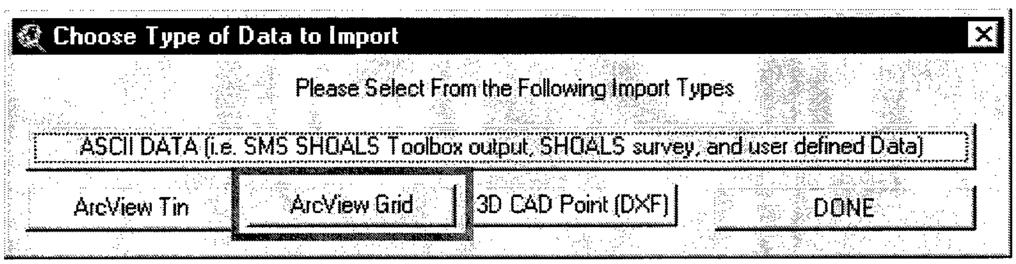


Figure 35. Import data format options dialog: *ArcView GRID* option

From here, the user can browse and select any available GRID data. Once selected, the GRID will be added to the current view and available for examination with the analysis tools.

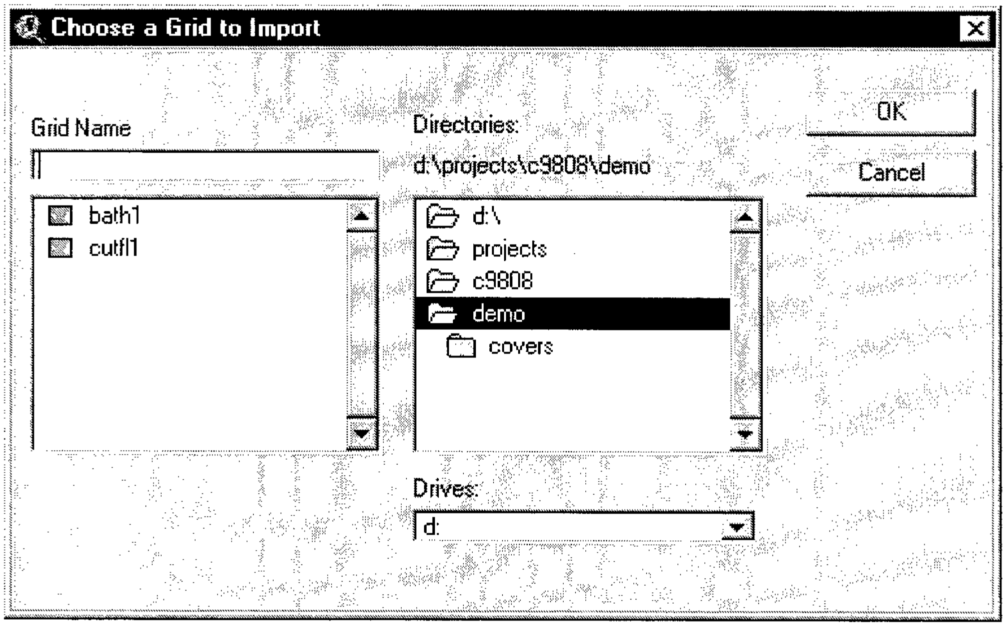


Figure 36. Import GRID file dialog

3-D CAD Point import option

Finally, users can import three-dimensional (3-D) CAD point data in DXF format. Most modern CAD packages have the ability to export data in the industry standard DXF format. Selecting the *3-D CAD Point (DXF)* button (Figure 37) on the Data Import dialog opens a file dialog box (Figure 38).

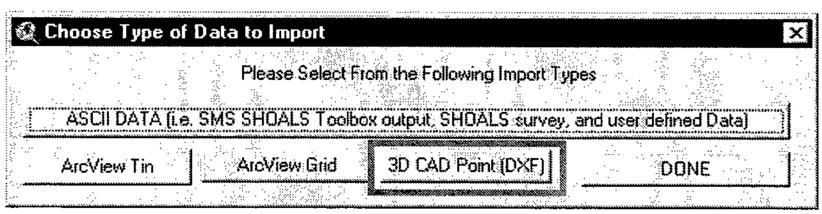


Figure 37. Import data format options dialog: *3-D CAD Point* option

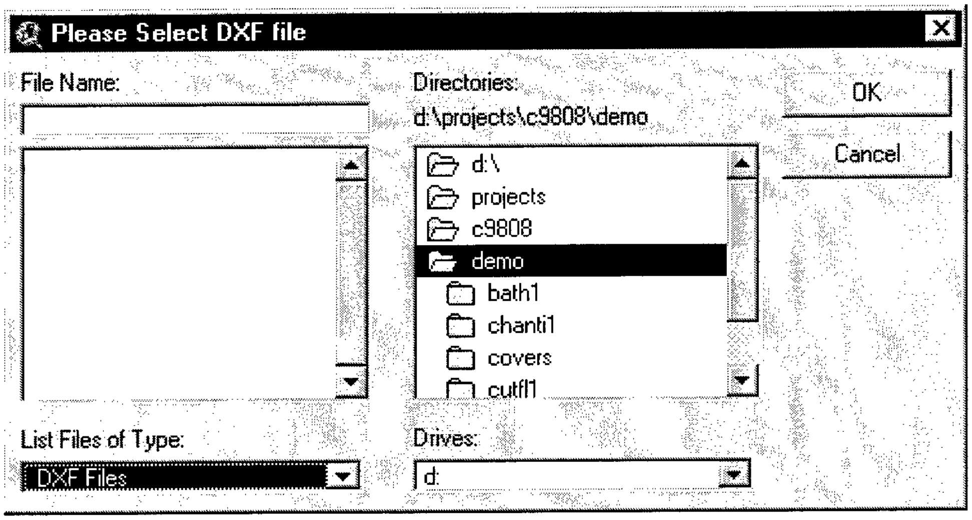


Figure 38. Import DXF file dialog

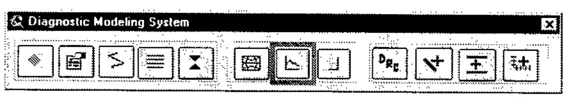
From here, the user can browse and select any available 3-D CAD Point (DXF) data. Once selected, the 3-D CAD Point (DXF) data is imported and the user is given the option to create themes (grid and/or point) from the data. Similar to the ASCII file import process, the final step defines the cell size and extent of the resulting grid. This grid will be added to the current view and available for examination with the analysis tools.

3 Components: Analysis Tools

Introduction

The four Data Manager analysis tools include the *Station Profile Display*, the *Volume Calculator*, the *Dredging Record Center*, and the *Reporting Tool*. The first two tools access the themes developed with the *Project Setup Tools* to assemble information about a project's condition. The *Dredging Record Center* is an autonomous database containing historic dredging records relative to a particular project. The *Reporting Tool* summarizes these data for user specified areas within a project. These tools are discussed in the following section.

Station Profile Display



The first analysis tool, the *Station Profile Display*, pulls cross sections from previously gridded surfaces. The tool works on any two grids simultaneously, pulling elevation and distance data from the same geographic locations on each surface. Various project information can be obtained from different grids. For instance, a condition survey grid combined with the channel template grid can indicate cross-sectional areas required to return the channel to its authorized depth. A comparison of pre- and postdredging grids can determine the cross-sectional area removed during maintenance dredging. Also, a postdredging grid can be compared to a condition survey grid to determine the shoaling rate in the navigation channel.

Cross sections are pulled from the grids along lines drawn graphically on the screen. These lines can be generated from two sources. First, the center-line stations can be used to pull uniformly spaced cross sections from the grid. The resulting cross sections will therefore be perpendicular to the channel center line and incorporate the channel template associated with each station. The second method requires the user draw a line segment on the screen across the area or interest. This line need not be perpendicular to the channel center line; in fact this could produce a cross section taken parallel the center line itself.

When the user selects the *Create Station Profile* button on the DMS toolbar, the first of three data selection dialog boxes appears (Figure 39).

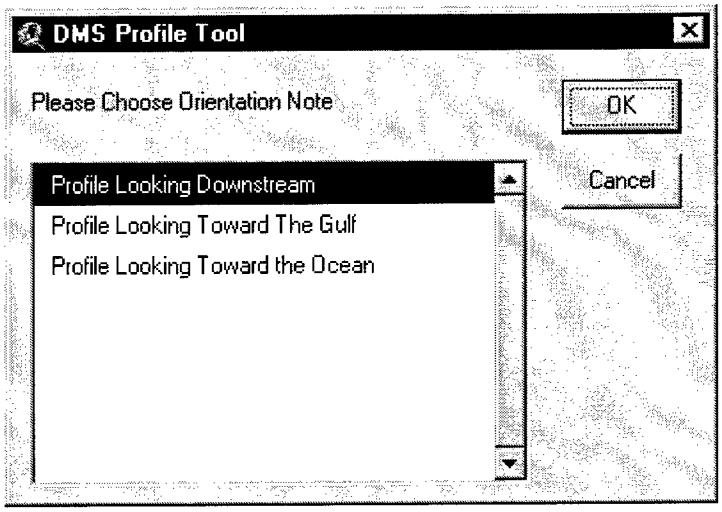


Figure 39. Orientation note dialog

This dialog prompts the user to select a note indicating the orientation of the cross-sectional view for the final graph. Next, the theme selection dialog (Figure 40) prompts the user to select two grids and a station selection method.

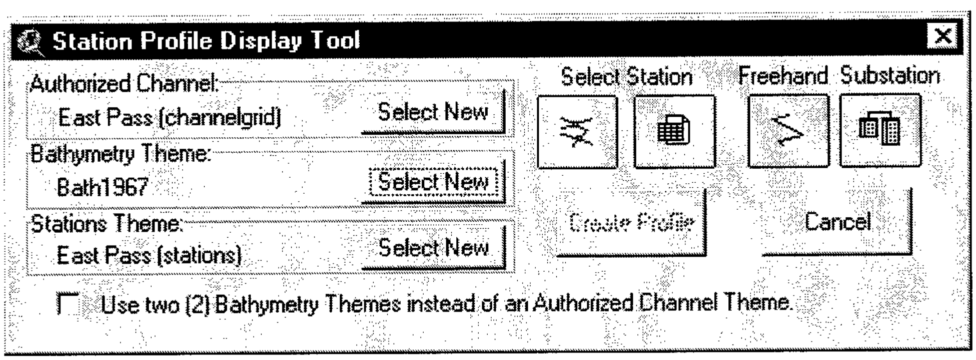
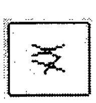


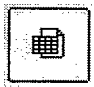
Figure 40. *Station Profile Display Tool* options dialog

By default, this dialog assumes the authorized channel template will be one of these themes. Alternatively, the user can select two bathymetry themes by activating the checkbox at the bottom of the dialog. In addition to the two grid themes, the user must also define a line theme for use as the station theme. The tool attempts to identify a previously created station theme based on the theme names in the active view.

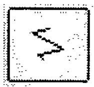
Users are offered four station selection methods to determine the area to pull cross sections. These methods are as follows:



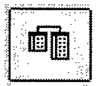
Select station by pointer: User clicks on an existing station in the view.



Select station by number: User selects a station number from a list box.



Click to draw a station: User draws a freehand station on the view.

Select  substation by number: User enters a substation between existing stations

Defining a station will enable the *Create Profile* button on the dialog. Clicking this button opens the final dialog (Figure 41).

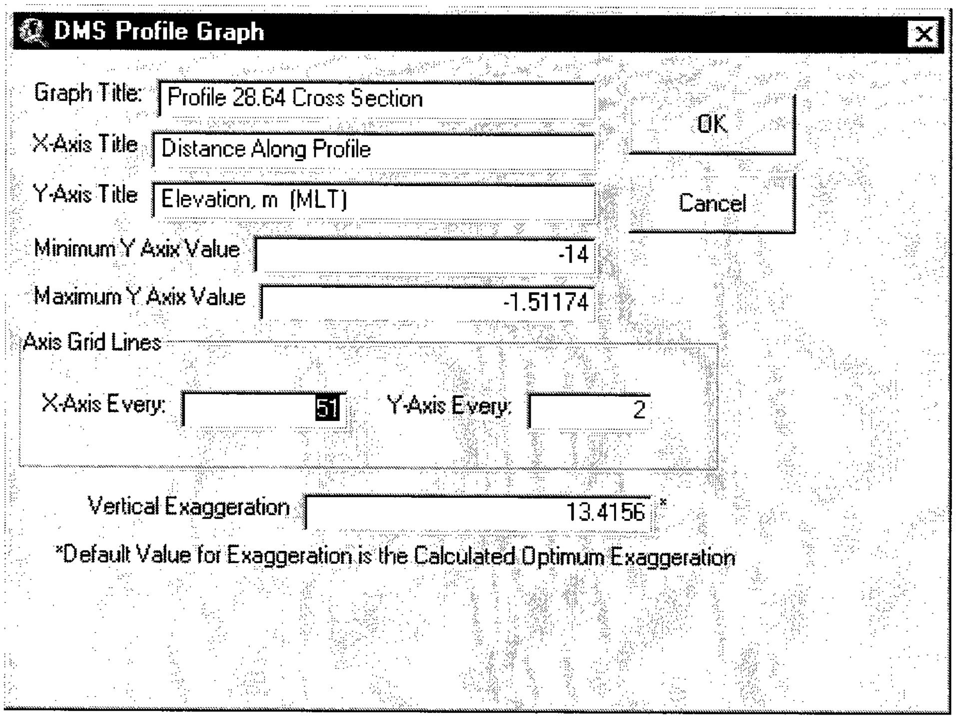


Figure 41. *Station Profile Tool* graph options dialog

This dialog allows the user to set graph formatting options. The overall graph title, as well as the X- and Y-axis titles, can be set to the users choice. Default values for the minimum and maximum extents of the Y-axis match the data extents; however, they can be set to any value. Grid lines can be defined for both axes as well. The default vertical exaggeration is calculated to distribute all the data evenly across the graph. The results, seen in Figure 42, are saved as a layout within the project.

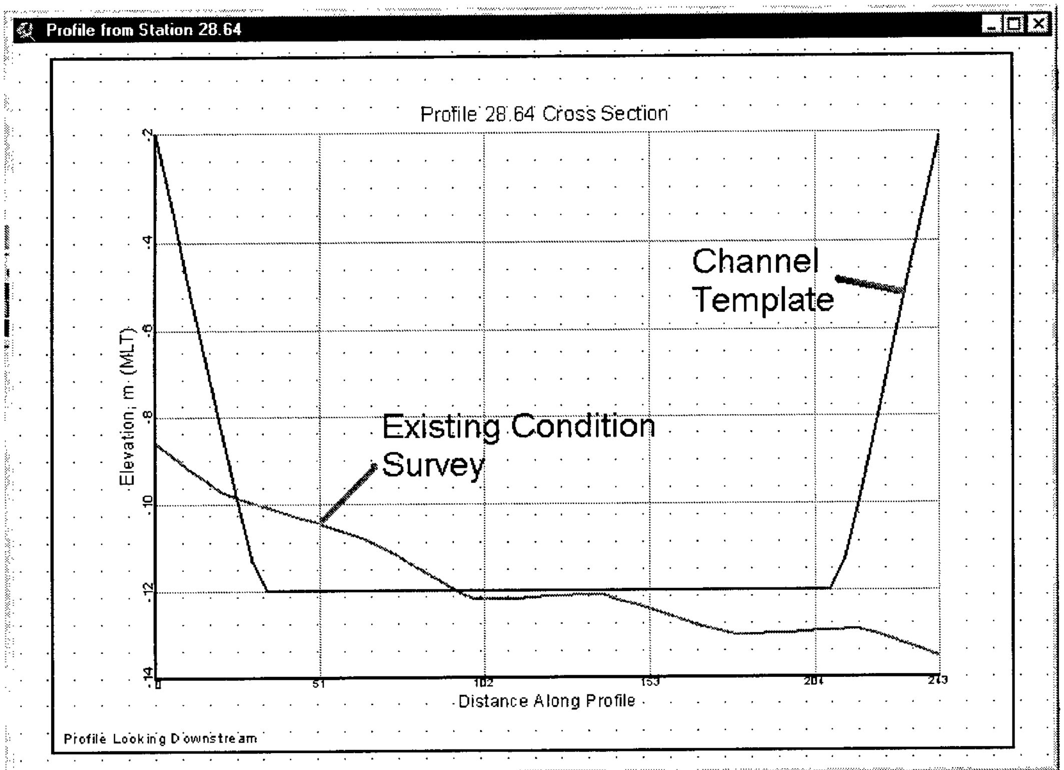
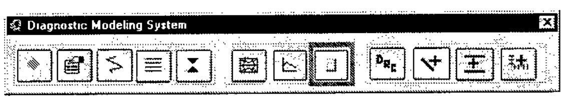


Figure 42. *Station Profile Tool* results

Volume Calculator



The *Volume Calculator* looks at volume calculation from the planform perspective. Working with two bathymetric grids, the tool uses the elevation differences associated with each grid cell and the area of the grid cell to calculate volume changes between surfaces. The result is a volume change grid that can be displayed using customized color schemes to emphasize known problem areas.

In a manner similar to the *Station Profile Display*, the compared grids determine what the results indicate. The *Stationing Tool* (Chapter 2) produces a channel template grid that can illustrate shoaling rates in the channel or required dredging volumes to maintain the authorized depth.

Selecting the *Volume Calculator* button on the DMS toolbar opens the *Volume Calculator Wizard.*

Step 1: Define themes

The first step requires the user to define the two grids that will be used in the volume calculations (Figure 43). The grid themes can either be the authorized channel grid and a bathymetric grid or two bathymetric grids. As with the *Station Profile* tool, the station theme must also be defined. Users also define the method to determine the area of calculation by selecting one of the three radio buttons. Clicking the bottom right button leads to the next step of the *Volume Calculator Wizard.*

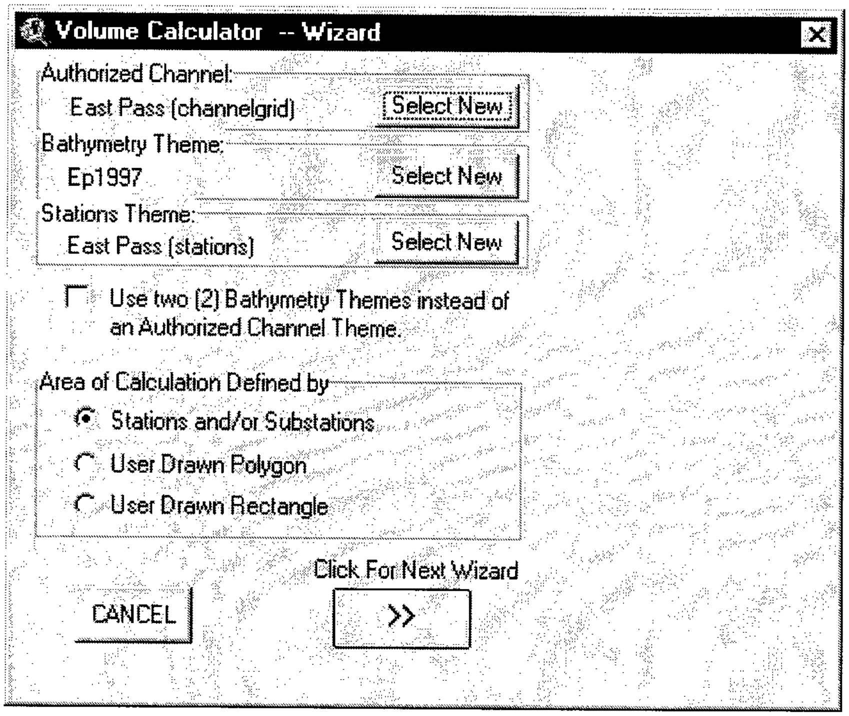


Figure 43. *Volume Calculator* options dialog

Step 2: Select area of calculation

The three methods to define the area of calculation vary from selecting stations and/or substations to graphically selecting an area. These methods are discussed in the following sections.

Station and/or substations. Stations and substations can be used to define the area of calculation. In a two-step process, the starting and ending stations are defined separately (Figure 44). Station selection options include graphically choosing an existing station from the view, choosing an existing station from a list box (Figure 45), or enter a station/substation number in a text box (Figure 46).

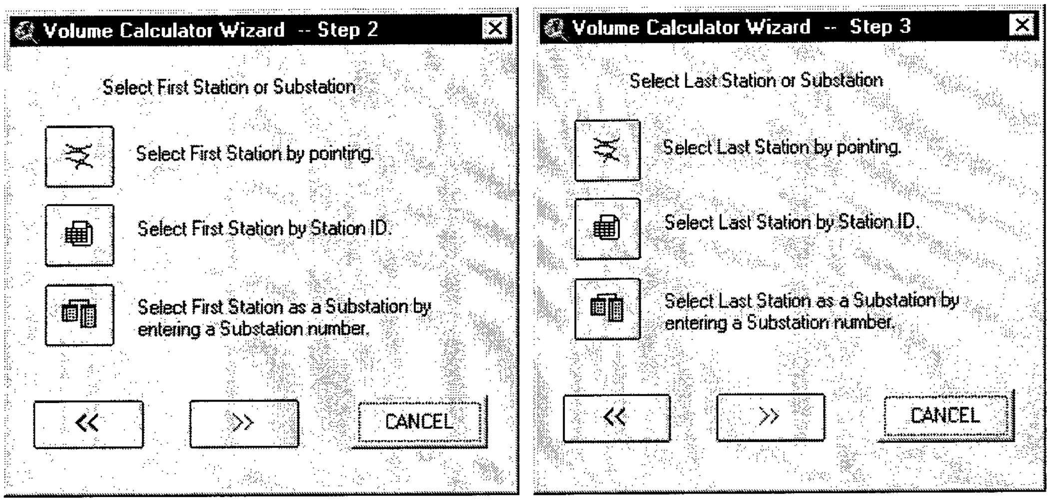


Figure 44. *Volume Calculator*: Station selection dialog

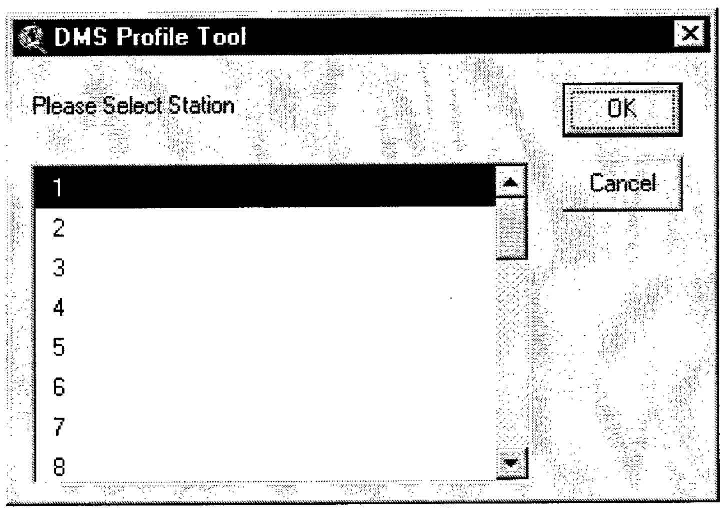


Figure 45. *Volume Calculator*: Select station list box

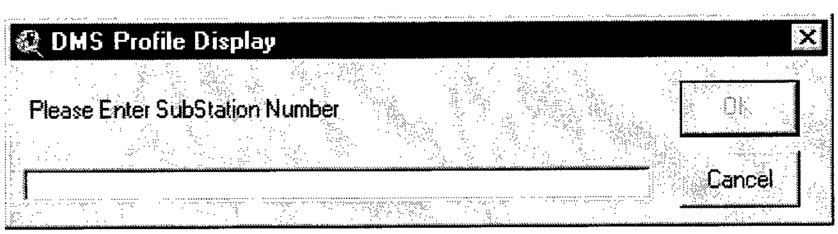


Figure 46. *Volume Calculator*: Substation data entry box

User drawn polygon. Users can select any overlapping area between the two grids by graphically drawing an irregular polygon on the current view. This can be used to examine specific sections of the authorized channel or, more generally, a particular area of interest.

User Drawn Rectangle. In a manner similar to the User Drawn Polygon option, the user can draw a rectangle over any overlapping area between the grids. The sides of the rectangle will be orthogonal to the coordinate system's axes.

Step 3: Overdredge options

After defining the calculation area, the user is prompted whether to include an overdredge scheme in the volume calculations (Figure 47).

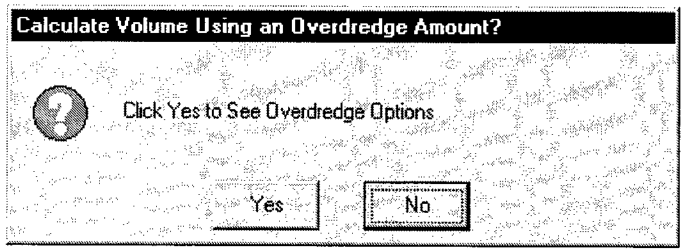


Figure 47. Include overdredge dialog box

If the user elects to include overdredge in the calculations, the *Overdredge Options* dialog opens (Figure 48). Corps Districts employ a variety of overdredging or advance dredging strategies to project planning efforts. Three options for applying the overdredge depth to the channel template are included in the dialog. The user first defines the amount of overdredge by setting the sliding bar to the appropriate value. Finally, the user selects one of the three methods of overdredge by clicking on the corresponding icon. This triggers the calculation process that produces a dialog with the calculated volume differences (Figure 49). The total accretion is the volume in the second grid above the first, while the total erosion is the volume in the second grid below the first.

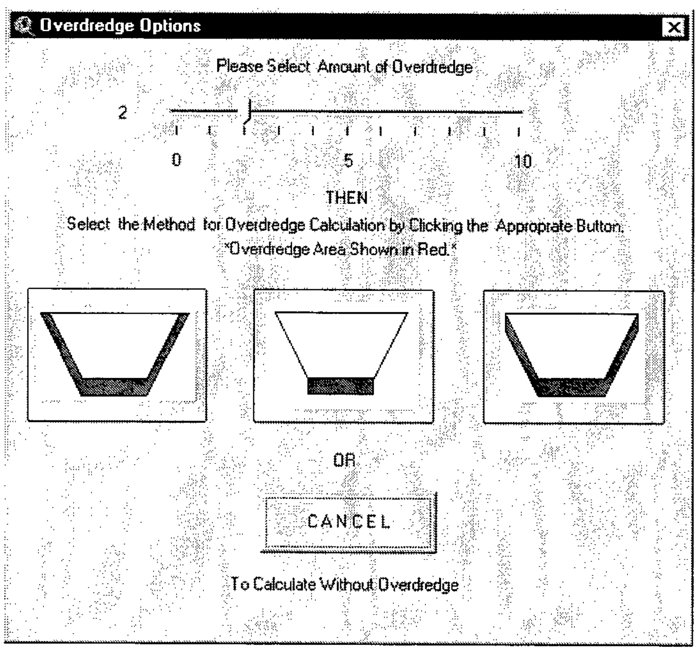


Figure 48. *Overdredge Options* dialog

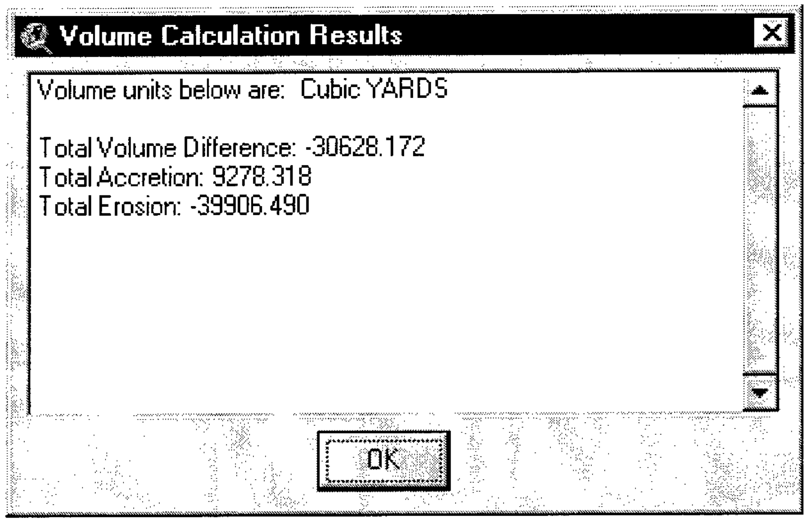
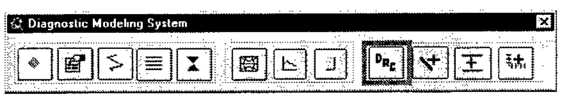


Figure 49. *Volume Calculator*: Results dialog

Dredging Record Center



The Dredging Record Center (DRC) provides a means for users to create and maintain a relational database of historic dredging records and tie these records to the geographic locations of the dredging. The database maintains several categories of data including dredging operational data, contract and cost information, contractor information, and dredge specific parameters. The DRC operates somewhat independently from the other analysis tools in that it is essentially a Microsoft Access database with a Visual Basic front end that communicates with the Data Manager GUI to reference geographic locations.

Launching the DRC opens a brief splash screen with general information on the program (Figure 50). The Data Manager passes the name of the current channel, as defined with the Project Setup tools, to the DRC. The database is queried with the channel name to select only the records corresponding to the current channel.

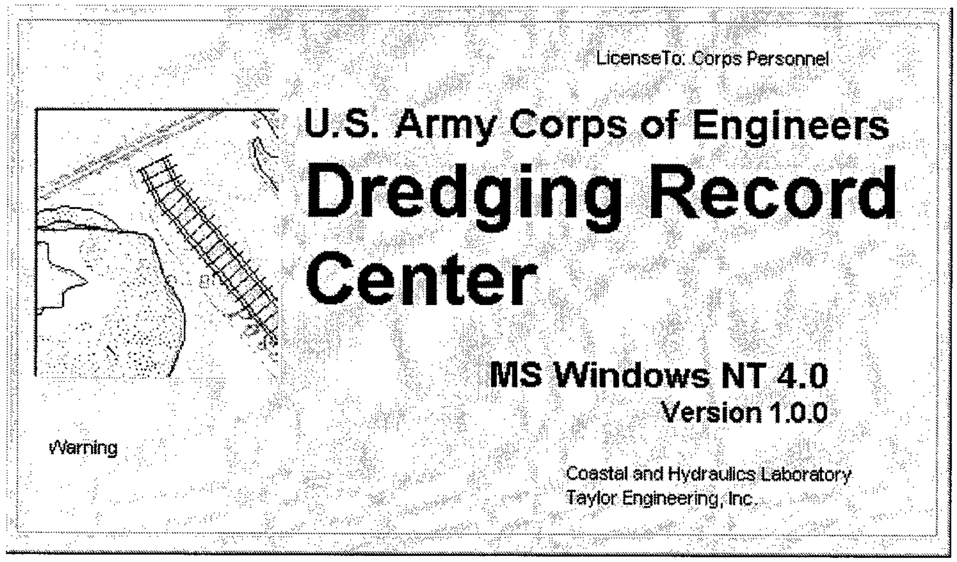


Figure 50. DRC splash screen

The opening DRC screen presents a data summary for the queried channel records (Figure 51). All identified dredging events are listed in a drop-down box. Users may select any event in the drop-down box to view the underlying data for that event. The following data are included for each dredging event: total cost, design volume, pay volume, contract number, starting and ending date, contractor, dredge and dredge type. Each project can consist of several dredged areas; these are summarized in the grid near the bottom of the screen. This dredging record summary form can be accessed at any time from within the DRC by clicking the *Open Dredging Records* icon.

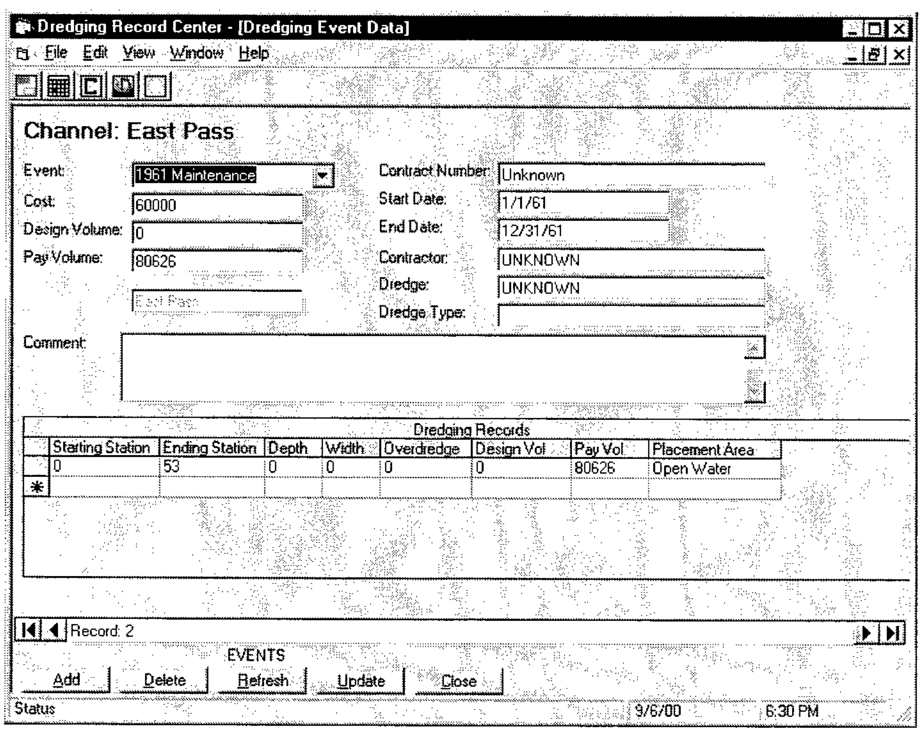


Figure 51. DRC data summary screen

Data entry

Users enter new dredging event data by clicking on the *Add* button or the *Open Event Database* icon. This opens the *Event Database* entry form (Figure 52). Fields in the *Event Database* entry form are not editable by default. Select the add button and a new, blank, and editable record is added to the database. Enter the appropriate data in the fields and select a contractor and dredge from the drop-down boxes. Click the *Update* button when finished and the database include the user's new event.

Existing records can be edited only after clicking the *Edit* button. Similarly, records may be deleted from the database by clicking the *Delete* button. The form may be closed at any time by clicking the *Close* button.

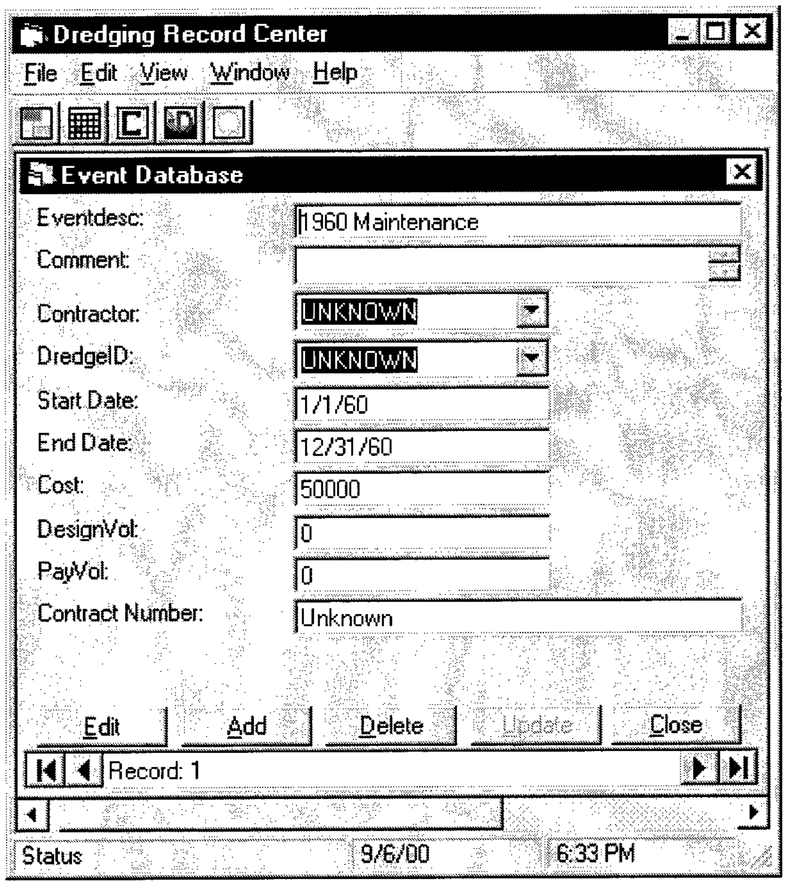


Figure 52. *Event Database* entry form

Individual dredging records can be entered by clicking on the *Individual Dredging Record* icon. This icon opens the *Individual Dredging Record* data entry form (Figure 53). Again, the user may add, edit, delete, and update records by selecting the appropriate button at the bottom of the form. Fields in the *Individual Dredging Record* data entry form are not editable by default. Select the add button and a new, blank, and editable record is added to the database. After selecting the correct event from the drop-down box, enter the appropriate data in the fields. Click the *Update* button when finished and the database include the user's dredging record.

Existing records can be edited only after clicking the *Edit* button. Similarly, records may be deleted from the database by clicking the *Delete* button. All records in the database can be viewed in grid format by clicking the *Grid* button.

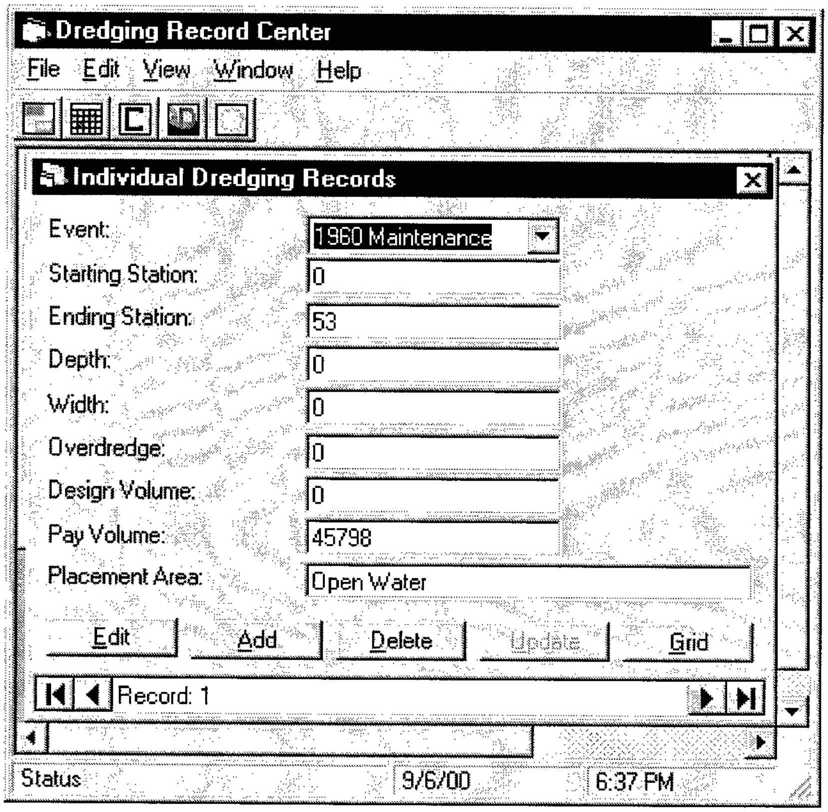


Figure 53. *Individual Dredging Record* data entry form

Contractor and dredge databases

The DRC contains the complete list of U.S. dredging contractors and U.S. flagged dredges as listed in the 1999 Directory of Dredge Owners & Operators in *International Dredging Review*. These data can be accessed by clicking one of the following icons:

 U.S. dredging contractors

 U.S. flagged dredges

The dredging contractors database includes mailing address, phone, fax, and e-mail information where available (Figure 54). If the contractor has established a Web site and Internet access is available on the current system, the user can visit the site from within the DRC via the DRC's own internal Web browser (Figure 55).

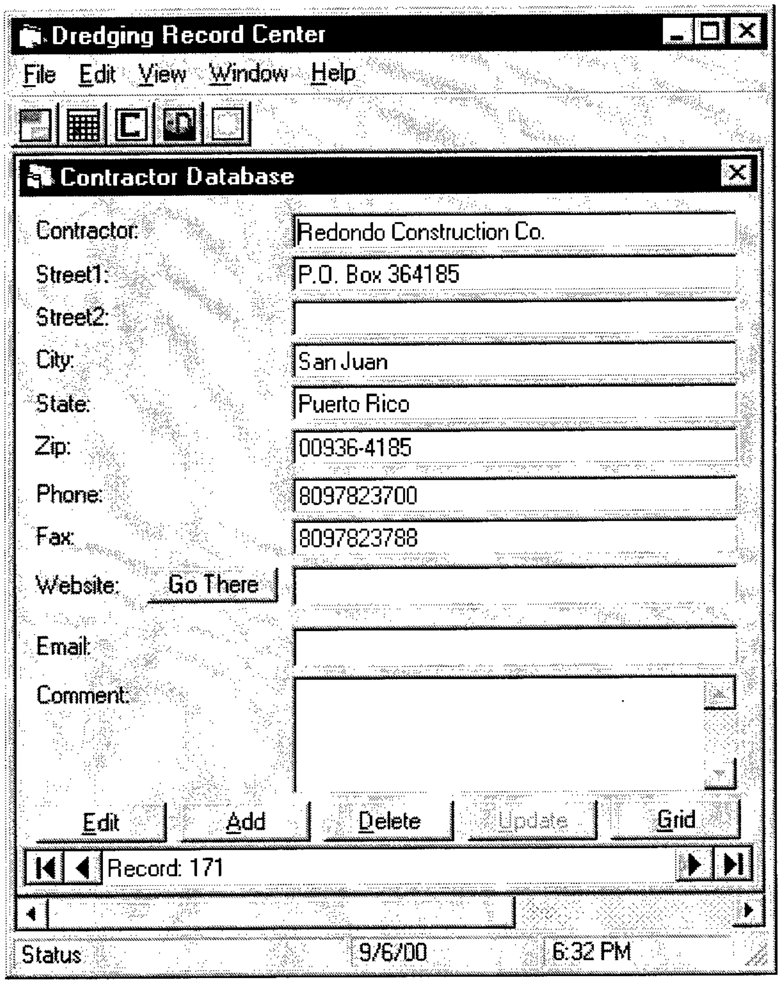


Figure 54. *Dredging Contractor* database form

Figure 55. Internal DRC Web browser

As previously noted, the *Dredge Database* contains all U.S. flagged dredges (Figure 56). The dredge types can be determined by referring to Table 1.

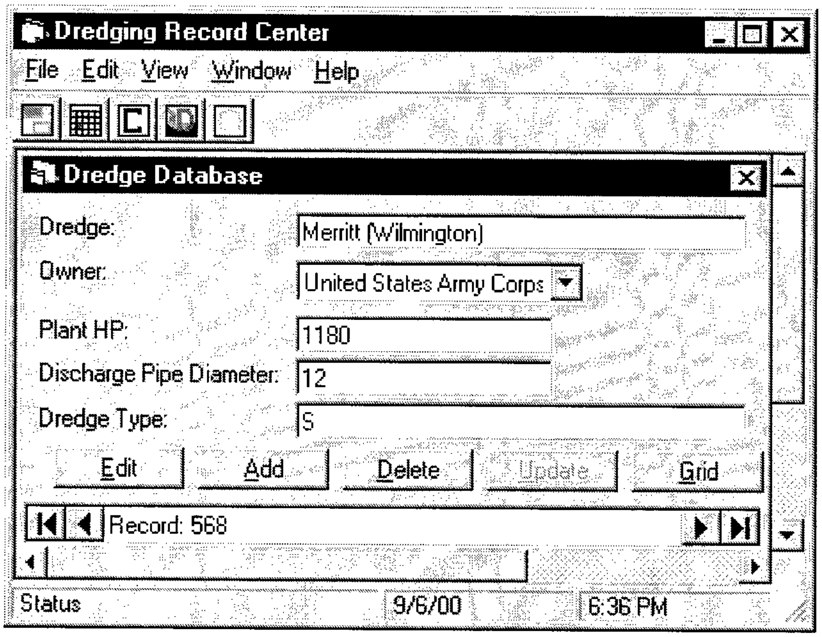
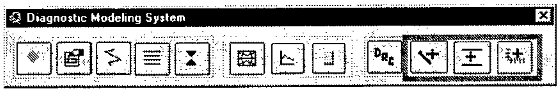


Figure 56. U.S. flagged *Dredge Database* form

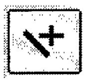
Table 1
Dredge Type Abbreviation Key

Abbreviation	Dredge Type
AU	Auger
BH	Backhoe
BL	Bucket Ladder
BW	Bucketwheel
CH	Cutterhead
CL	Clamshell (Grab)
CR	Chain Ladder
DI	Dipper
DP	Dustpan
H	Hopper (Trailing Suction)
S	Suction

Reporting

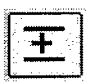


Currently, the Data Manager can produce three formatted reports, a single station report, multiple station or area report, and an overall project report. Each report contains graphical representations of volumes dredged, project costs, and shoaling rates.



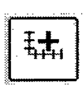
Station report

Selecting the *Station Report* button on the DMS toolbar activates the station selection tool. The user can then click on any previously created station to produce a report of all dredging activity listed in the DRC for that station. The report includes graphs of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event. Design and pay volumes are totaled and used to calculate a shoaling rate based on the range of dates for the returned dredging events.



Area report

Selecting the *Area Report* button on the DMS toolbar activates the area selection tool. The user can then draw a polygon around any group of previously created stations to produce a report of all dredging activity listed in the DRC for those stations. The report includes graphs of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event. Design and pay volumes are totaled and used to calculate a shoaling rate based on the range of dates for the returned dredging events. Finally, the report tabulates all pay volumes.



Project report

Selecting the *Project Report* button on the DMS toolbar automatically queries the DRC database for all dredging activity that has occurred within the project. The report includes graphs and tables of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event. Design and pay volumes are totaled and used to calculate an overall shoaling rate based on the range of dates for the returned dredging events.

4 DMS Data Manager Example Application Tutorial

Introduction

DMS Technical Report 2 (Gosselin, Craig, and Taylor 1999) documents an application of DMS concepts to East Pass, FL. This chapter focuses on the DMS Data Manager setup and analysis procedures performed in support of this report. The Data Manager helped to identify several problematic shoaling areas within the Federal project. The next section provides background information on East Pass, followed by the step-by-step application of the Data Manager.

Taylor Engineering developed the state-mandated inlet management plan for the inlet (Gosselin, Hull, and Taylor 1999) in cooperation with the City of Destin; Okaloosa County; the Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems; and the U.S. Army Engineer District, Mobile. This report details the application of the Data Manager to East Pass.

East Pass, FL – Background

East Pass provides the only direct tidal link between the Gulf of Mexico and Choctawhatchee Bay. Measuring approximately 1,219.2 m (4,000 ft) long and 304.8 m (1,000 ft) across between the tips of the jetties, East Pass is located about 83.5 km (45 miles) east of Pensacola and 92.7 km (50 miles) northwest of Panama City. Figure 57 shows the configuration of East Pass and adjacent areas. Situated at the coordinates 30°23'N and 86°31'W, East Pass is positioned between Santa Rosa Island to the west and Moreno Point to the east. At 83.5 km (45 miles), Santa Rosa Island, the second longest barrier island on the entire Gulf Coast, spans from East Pass on the east to Pensacola Pass on the west. Moreno Point is the western edge of a headland separating Choctawhatchee Bay from the Gulf of Mexico. The City of Destin is located on Moreno Point north of the inlet. On the east side of the pass near the jetties is a sand spit, known as Norriego Point, which formed in 1935. This spit and the beach direcly east is known as Holiday Isle. The spit has been developed with roads, canals, and condominiums since the 1970s.

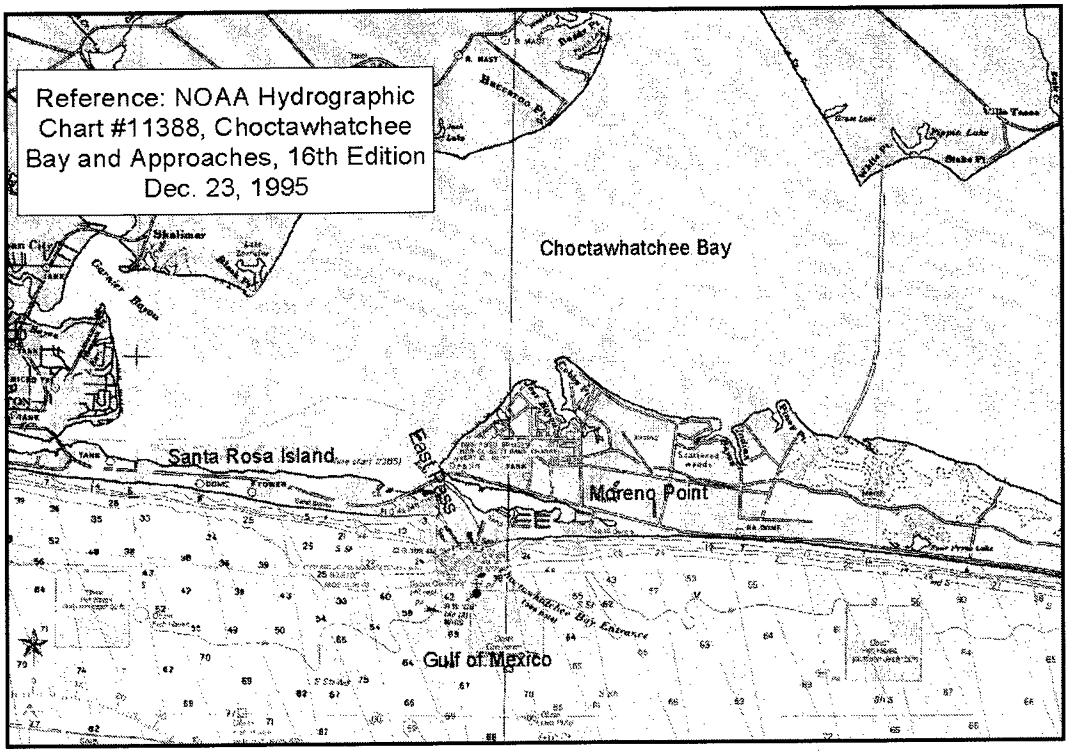


Figure 57. East Pass project area

Navigation through the East Pass in the 1930s proved quite perilous for small vessels. The crescentic bar at the outermost edge of the ebb tidal shoal had a history of shifting significantly during storms. In addition, government acquisition of Valpariso Airport, which would later become Eglin Air Force Base, meant that channels through the pass required modification and maintenance to allow passage of military vessels. Before 1945, dredging occurred periodically to maintain a 1.83 x 30.5-m (6 x 100-ft) channel through East Pass. In June 1945, the Air Force contracted the Corps to dredge a channel 3.66 m (12 ft) deep and 54.9 m (180 ft) wide through East Pass (U.S. Congress, House 1950). In 1951, Congress authorized the dredging of a 1.83 x 30.5-m (6 x 100–ft) channel extending from the east end of the U.S. Highway 98 bridge through Old Pass into Old Pass Lagoon. The rapidly shoaling East Pass channel quickly returns to about 2.13 or 2.44 m (7 or 8 ft) deep at mean low water (mlw). Consequently, maintenance dredging must be continuously scheduled.

To improve the inlet's navigational safety and to reduce annual maintenance costs, the 1963 USACE survey report recommended constructing jetties to protect the entrance to the Gulf of Mexico. The report also recommended a substantial amount of dredging to coincide with jetty construction. The total estimated cost of the project was $1.87 million. Jetty construction and dredging began in December 1967 and ended in January 1969. The jetties featured a converging design constructed to the -1.83 m (-6 ft) mlw contour that ends with an opening 305 m (1,000 ft) across (U.S. Army Engineer District, Mobile 1967). A 305-m (1,000-ft) weir was placed in the west jetty near the landward end to allow littoral drift to enter a deposition basin on the opposite (east) side of the weir. Between April and June 1969, a few months after completion of the jetties, a 30.5 m (100-ft) section of the weir collapsed. In addition, concern grew over the continuing erosion of Norriego Point and the western tip of Moreno Point. Popular opinion held that the weir allowed large waves to pass through and erode the point. In 1983, under pressure by local interests, the Corps (U.S. Army Engineer District, Mobile, 1983) recommended weir closure. In 1985, the Corps permanently closed the weir by covering it with a rubble-mound trunk section identical to that used on the rest of the jetty.

General inlet maintenance occurred in 1977 with the construction of a 91.4-m (300-ft) rubble-mound spur that attached at a right angle to the landward end of the east jetty. The purpose of the spur was to divert flow away from the landward terminus of the jetty. By the 1980s, scour holes had formed at the tip of the spur as well as at the tip of the west jetty (Lillycrop and Hughes 1993). Until 1993, maintenance of the spur jetty had been limited to the placement of dredge material, riprap stone, and concrete rubble in the scour hole. More extensive repairs were completed in 1994.

In its present configuration, East Pass consists of two primary Federal navigation channels, the Old Pass Entrance to Destin Harbor and the East Pass Federal Navigation Channel. Old Pass is a 1.83 x 30.5-m (6 x 100-ft) channel extending from the east end of the U.S. Highway 98 bridge through Old Pass into Old Pass Lagoon. East Pass is a 3.7 by 54.9-m (12- by 180-ft) channel extending from the U.S. 98 bridge, through the jetties and offshore through the ebb shoal.

Case Study – East Pass, FL

The case study of East Pass involved testing and evaluating the concepts driving Data Manager development. The initial step in developing a Data Manager project is selection of a common coordinate system for the data. All data shown on the following pages are referenced to the State Plane Coordinate System, North American Datum of 1927, Florida North Zone.

The focus of this application is on the problem shoaling area in the channel bend only. Other problem areas or the entire project can be assessed by similar methods.

Step 1: *Setup Wizard*

The East Pass Data Manager project begins with the *Setup Wizard*. Select the *Create a New View* option. The parameters that will be entered in the next screen of the *Setup Wizard* include:

Project:	East Pass, Florida
Data Projection:	State Plane Coordinates, NAD 1927, Florida North Zone
Coord. System Units:	feet
Vertical Datum:	NGVD 1929
Project Working Directory:	d:\projects\c9808\trdemo

Corps District: Mobile

State: Florida

Figure 58 shows the East Pass project parameters as entered in the *Setup Wizard.*

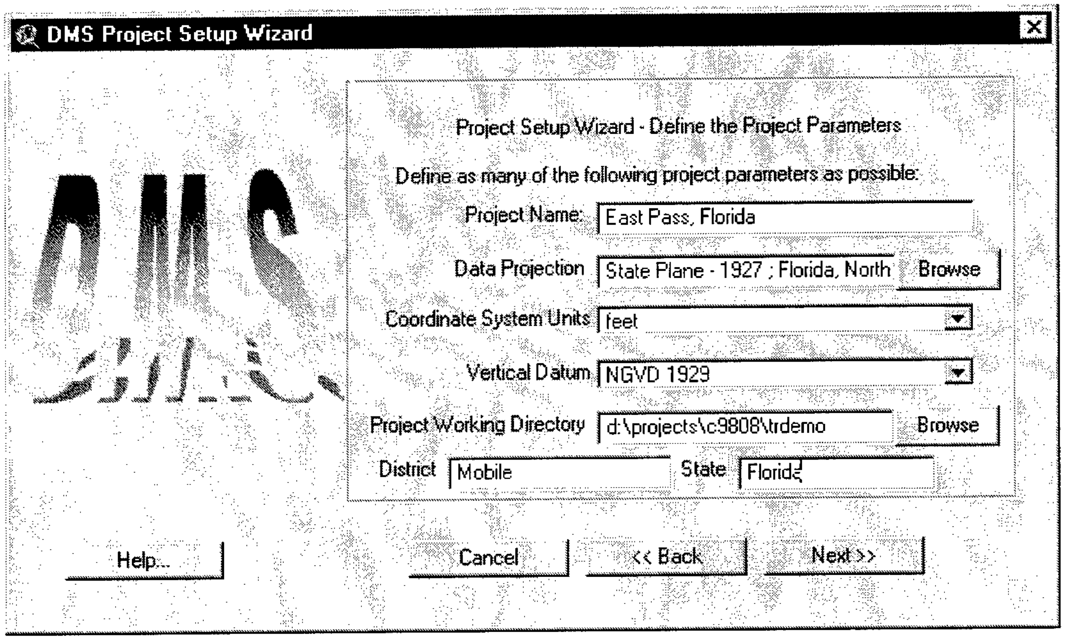


Figure 58. East Pass project parameters

The *Setup Wizard*'s final screen allows the user to select various base map data to include in the new view. Select the *Basemap Image Data* browse button. This opens a file dialog that by default, opens in the project working directory (Figure 59). Select the file "ep.jpg", a JPEG image of the USGS 7.5" Quadrangle covering East Pass, and click *OK.*

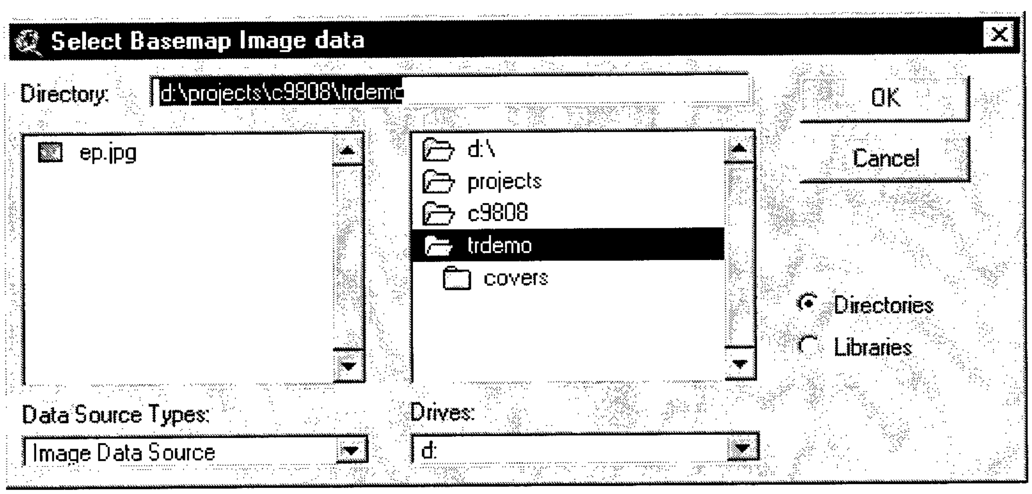


Figure 59. East Pass base map image file dialog

Now select the *Project Coverages* browse button. Switch to the *covers* subdirectory and select the three ArcView shape files (Figure 60). Click *OK*.

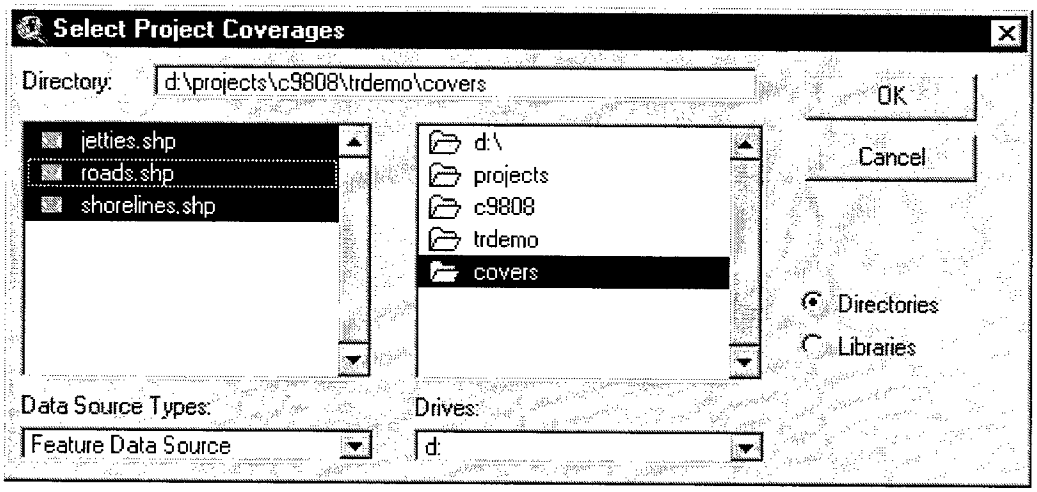


Figure 60. Select East Pass project coverages file dialog

Grid data will not be included at this point. Select *Finish* and a new view is created (Figure 61).

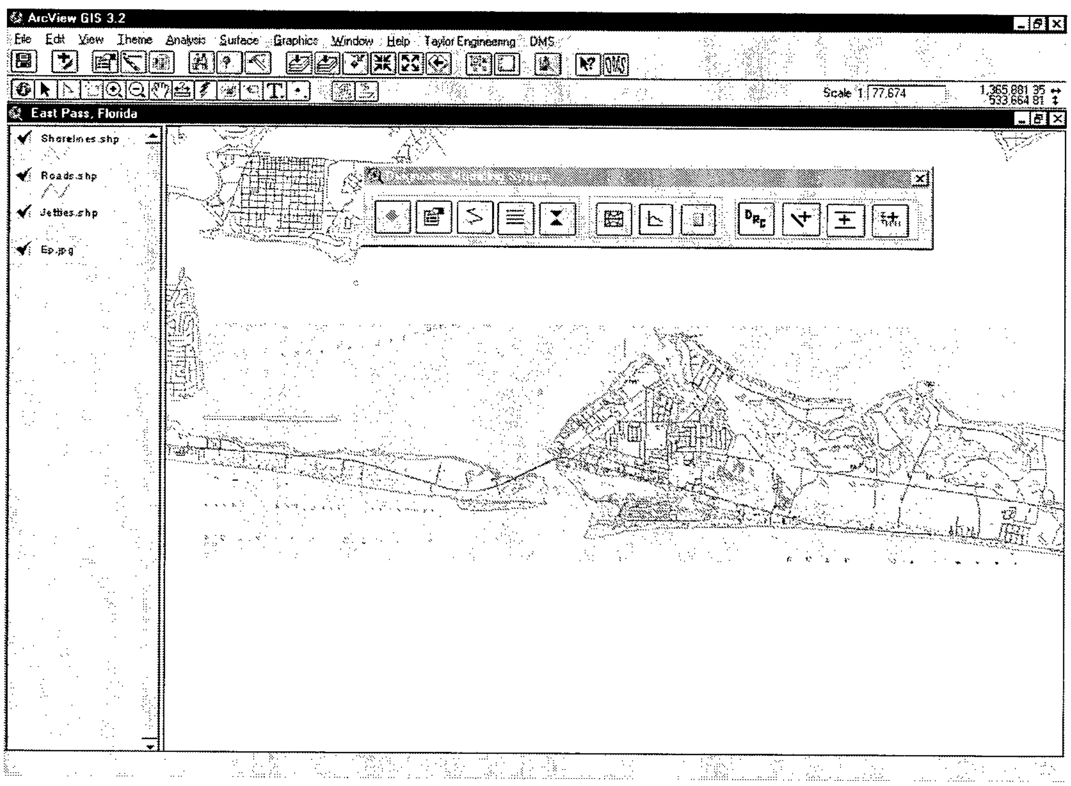


Figure 61. Data Manager view of East Pass with base map information

Step 2: *Stationing Tool*

The Data Manager next prompts to add a center line. Select *Yes* to begin the *Stationing Tool.*

A file dialog box opens to allow the user to select an ASCII file containing center-line coordinates. Choose the file *centerline coordinates – east pass.txt* and click *OK* (Figure 62).

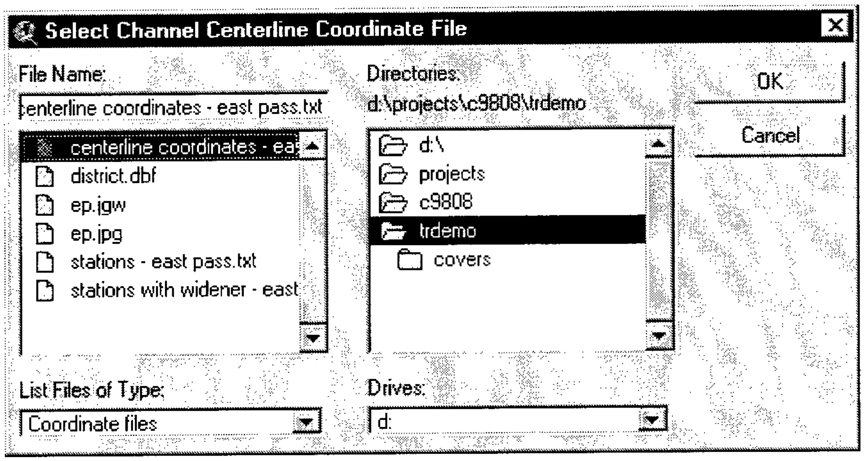


Figure 62. East Pass channel center-line coordinate file dialog

Enter *East Pass* as the channel name (Figure 63).

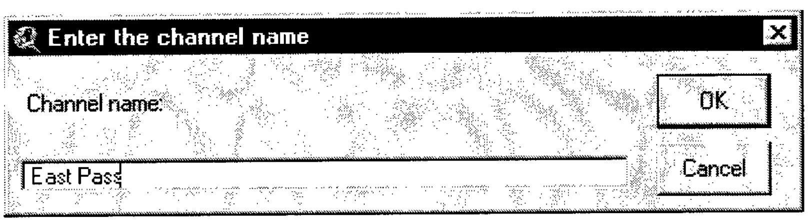


Figure 63. East Pass channel name dialog

The file contains data in comma-delimited X, Y format without a header line. Set the appropriate options in the dialog box and click *OK* (Figure 64).

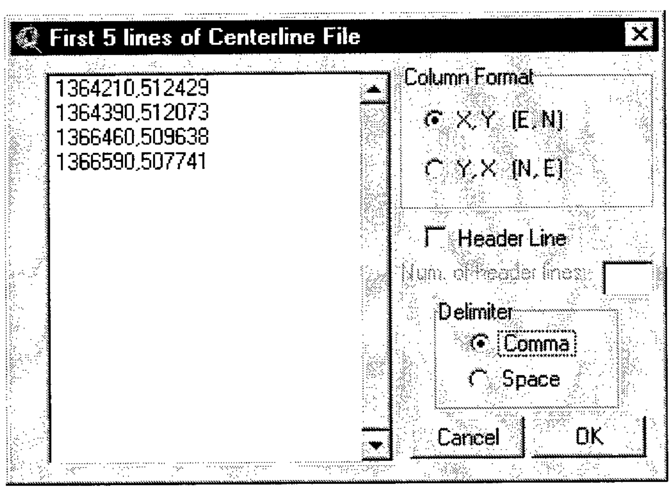


Figure 64. East Pass center-line file format dialog

The center line is added to the view. Select the center-line theme and zoom to its extent by pressing the *Zoom to Active Theme(s)* button. Figure 65 shows the current view.

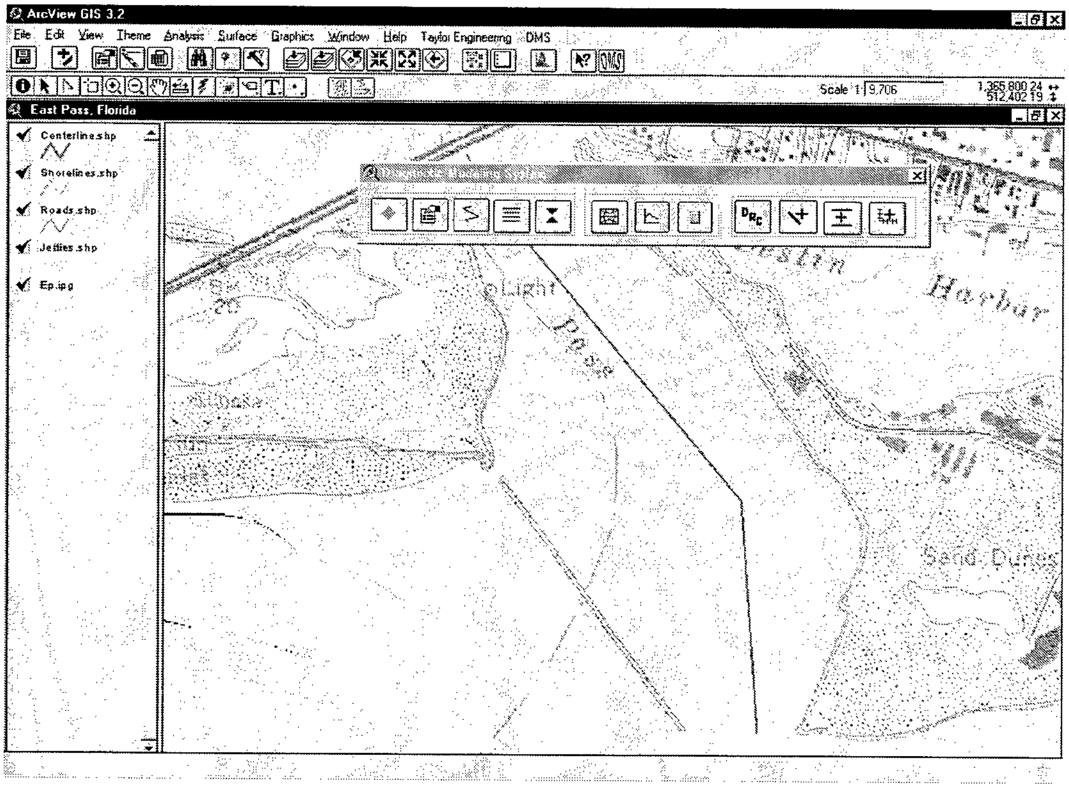


Figure 65. Data Manager with East Pass channel center line

Now, the *Stationing Tool* asks the user to add station information. Click *Yes*. The *Station Definitions* dialog opens (Figure 66). Choose to *Import an ASCII File*. The starting station number is 1.0, whole stations are 30.5 m (100 ft) apart, and stations will be extended 15.3 m (50 ft) beyond the top width of the channel.

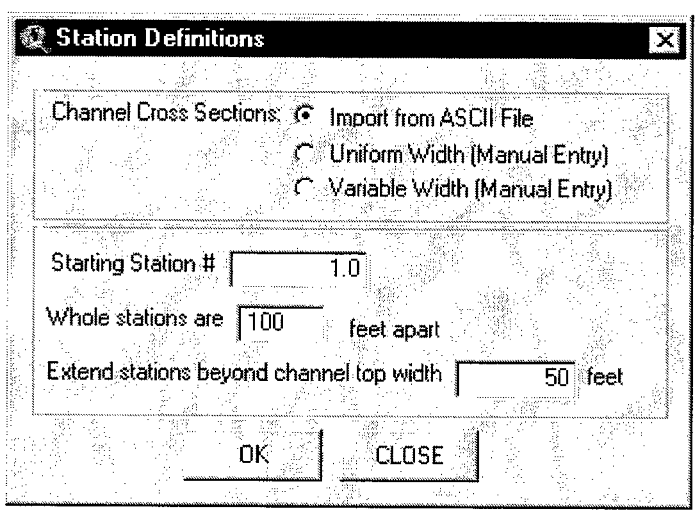


Figure 66. East Pass station definition dialog

Name the output themes *East Pass TR3* (Figure 67).

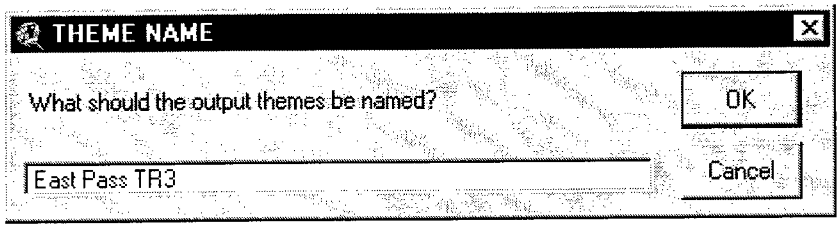


Figure 67. Name output theme *East Pass TR3*

Again, a file dialog opens to the project working directory (Figure 68). Scroll down the file list and select the file named *stations with widener – east pass.txt*. This file contains the station number, left width, right width, authorized depth, and side slope for each station in the channel. Click *OK*.

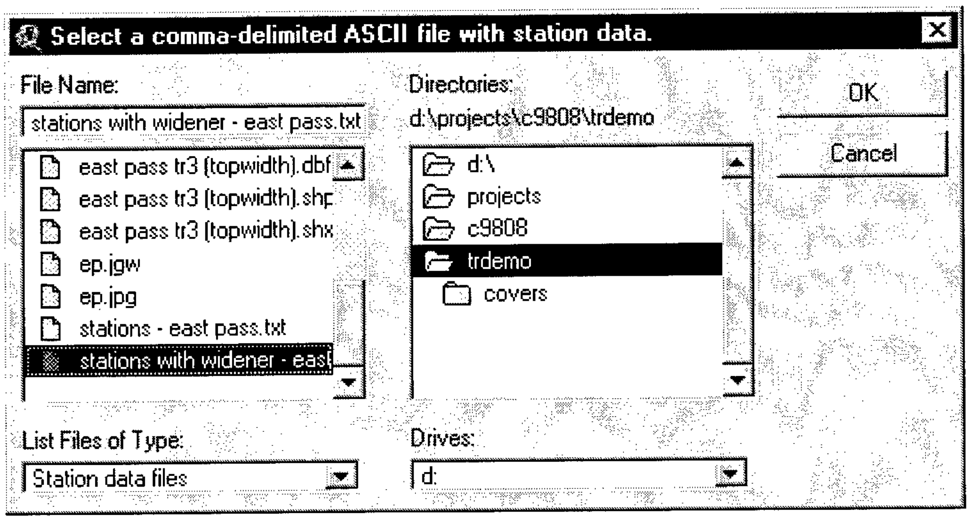


Figure 68. East Pass station data file selection dialog

The next dialog shows that the file contains a single header line (Figure 69). Click *Yes* to tell the *Stationing Tool* that the header line exists.

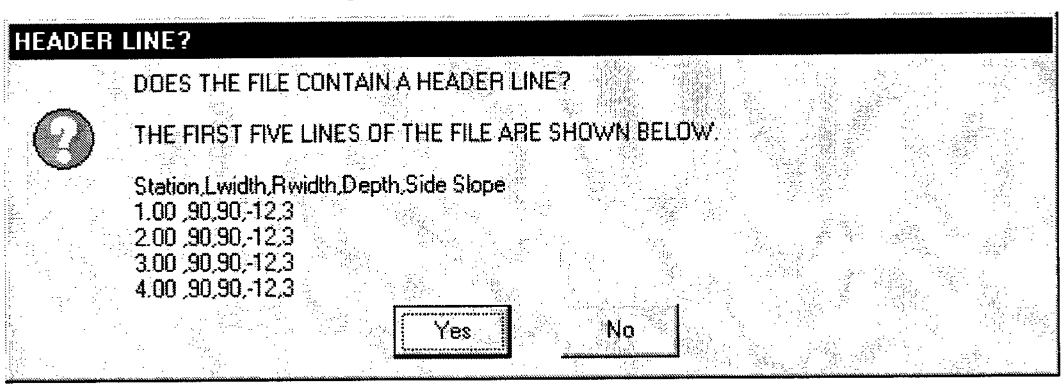


Figure 69. East Pass station file option dialog

Select *No* when asked to include a TIN of the channel surface. This is not necessary for the following analyses. Select the default grid size of 5 ft (1.5 m) (Figure 70).

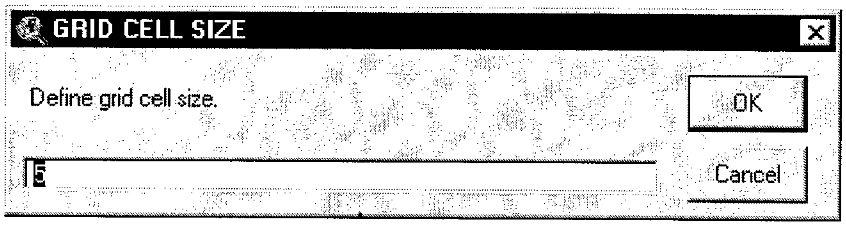


Figure 70. East Pass grid cell size dialog

Select *OK* where cautioned not to remove the newly created themes.

Four themes have been added to the view. These include the following:

a. East Pass TR3 (stations) – station line theme.

b. East Pass TR3 (channel) – channel bottom width polygon theme.

c. East Pass TR3 (topwidth) – channel top width polygon theme.

d. East Pass TR3 (channelgrid) – channel template grid.

Turn the station and grid themes on by clicking the check boxes adjacent to each theme name (Figure 71). The grid displays the East Pass channel from just south of the U.S. 98 bridge to the seaward end of the jetties. Stations are shown at 100-ft (30.5-m) spacing except at PI's and the beginning and end of the widener. The project base map is now complete. Next, we will add bathymetric data to the project.

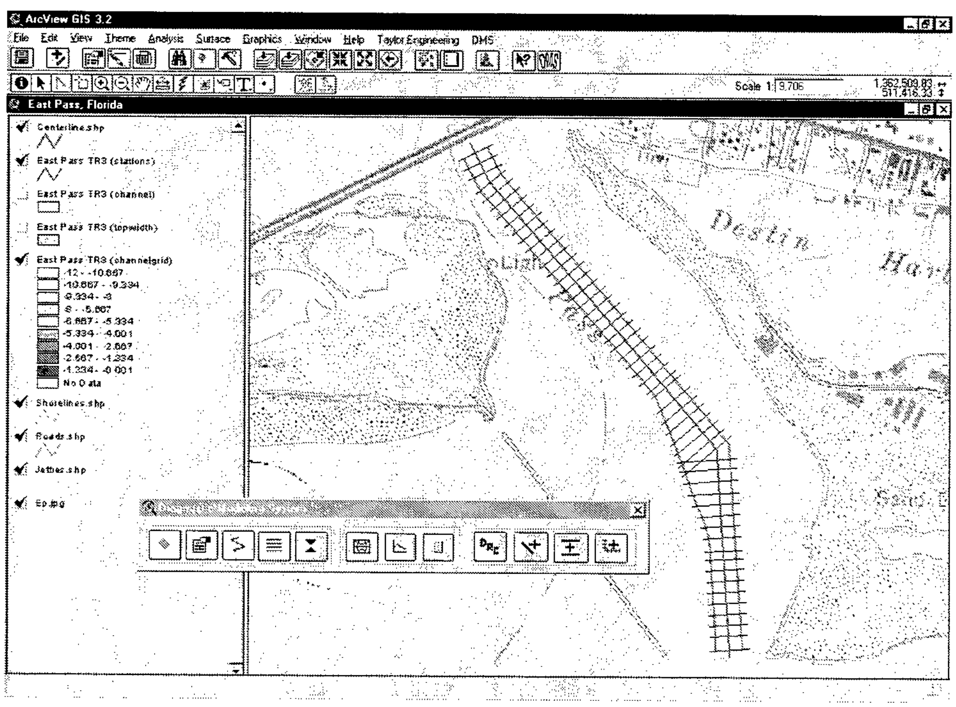


Figure 71. East Pass stations and channel template grid

Step 3: *Import Bathymetry*

Start the Import Bathymetry tool by clicking the icon on the DMS toolbar or selecting the *DMS|Import Bathymetry* menu item. Select the *ASCII Data* option from the initial dialog, then choose *Generic ASCII Data* on the *Import ASCII Data* dialog. In the file dialog, select the file named *1985.txt* (Figure 72). This file contains data from a condition survey performed in 1985.

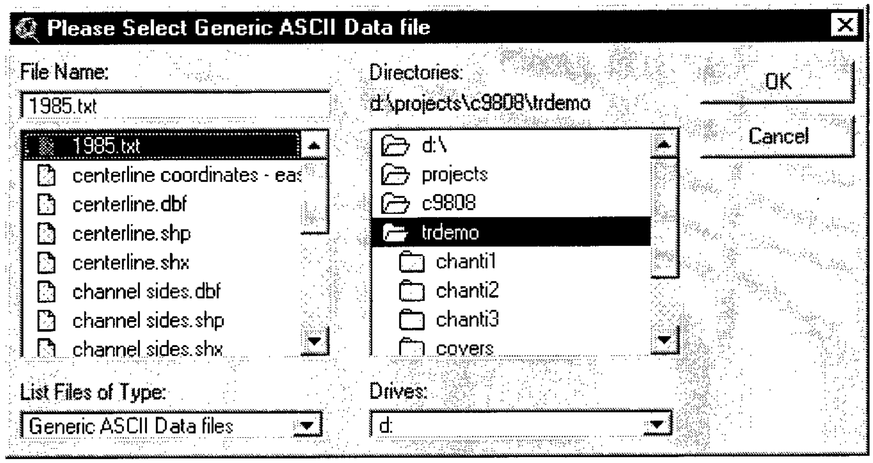


Figure 72. East Pass bathymetry file selection dialog

The next dialog summarizes the data in the file (Figure 73). Note that the file does not have a header line and is space-delimited. The first column contains X data, the second column contains Y data, and the third column contains Z data. Click the *Import the File* button.

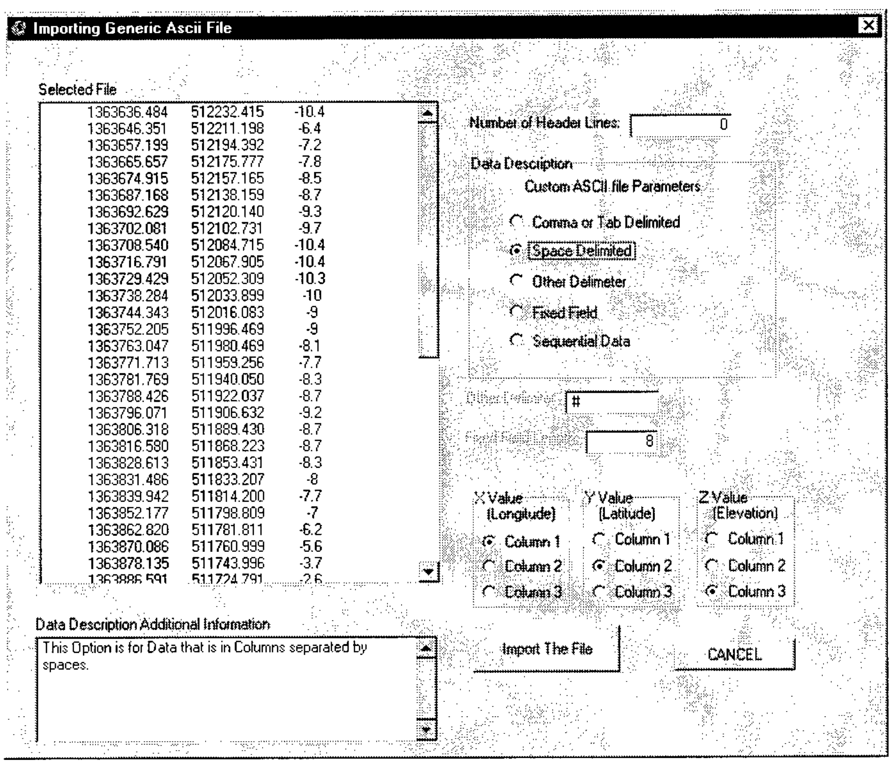


Figure 73. 1985 bathymetric survey data format dialog

On the *Import ASCII Data* dialog, the *Create Bathymetry* button is now enabled. Click this button. When prompted to define the *Themes to Create*, select the *Bathymetry Surface and Point Theme* options (Figure 74). Set the name of the *Bathymetry Surface* to *EP1985* and the *Point Theme* to *EP1985pts*. Click continue.

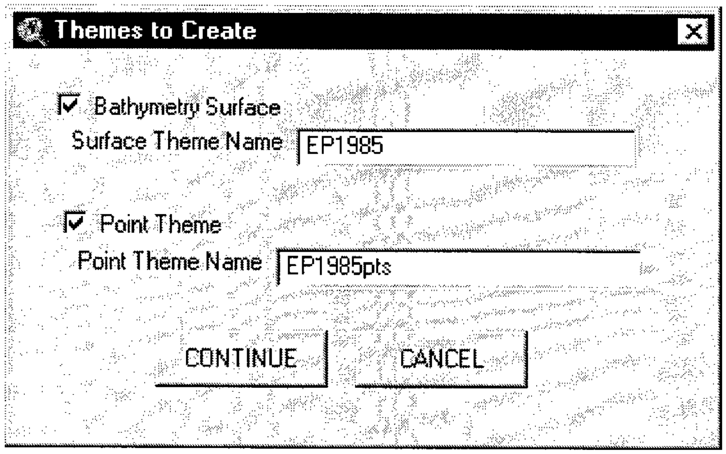


Figure 74. Define East Pass bathymetric theme names

The point theme is created first. When asked to set the grid parameters, set the *Output Grid Extent* to *Same As EP1985pts.shp* (Figure 75). Set the *Output Grid Cell Size* to *Same As East Pass TR3 (channelgrid)*. This will create a grid at the extents of the survey data with the same resolution (5 ft or 1.5 m) as the channel template grid.

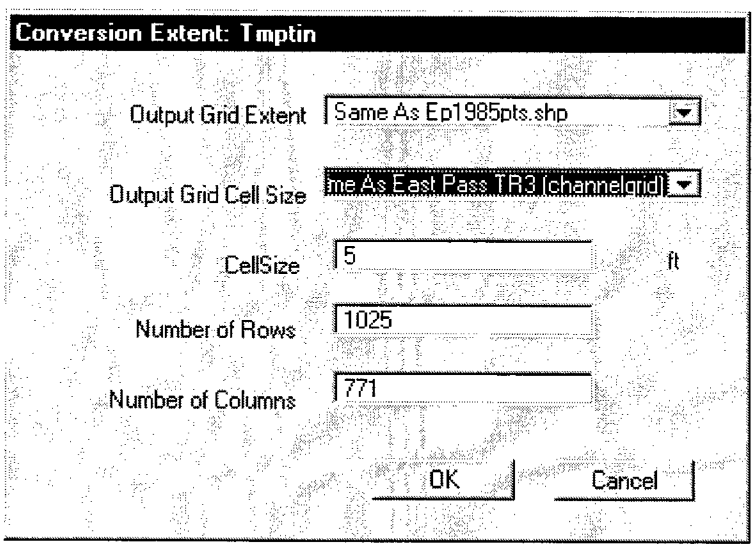


Figure 75. East Pass bathymetric grid definition dialog

The grid is added to the view. Drag the new grid to just above the JPEG image in the Table of Contents. This will overlay the channel template and other base map information on the new bathymetric grid (Figure 76).

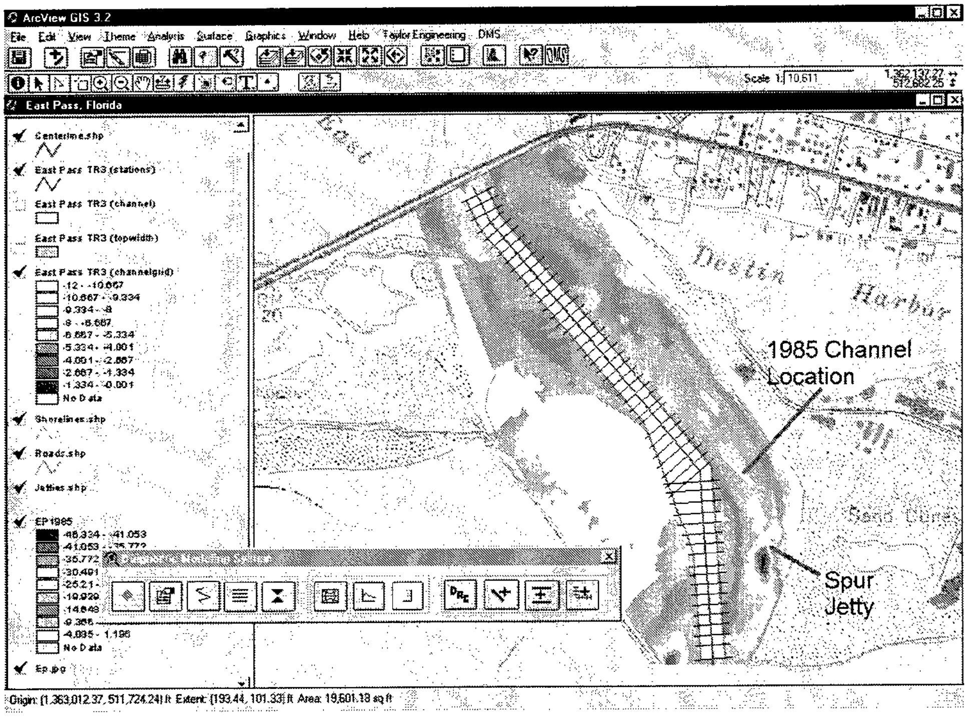


Figure 76. Results of 1985 bathymetric survey

Several interesting features can be seen in this view. First, the orientation of the channel in 1985 was much further east than the authorized channel. A large shoal exists from the west jetty across the authorized channel near the channel bend. Also, a large scour hole exists offshore of the spur jetty near the landward terminus of the east jetty.

Step 4: *Station Profile* analysis

The newly created data can be examined with the *Station Profile Tool.* Activate the tool by clicking on the *Station Profile* icon on the DMS Toolbar. Set the *Orientation Note* to *Profile Looking Toward the Gulf.* In the *Station Profile Display Tool* dialog, set the *Authorized Channel* theme to *East Pass TR3 (channelgrid)*, the *Bathymetry Theme* to *EP1985*, and the *Stations Theme* to *East Pass TR3 (stations)* (Figure 77).

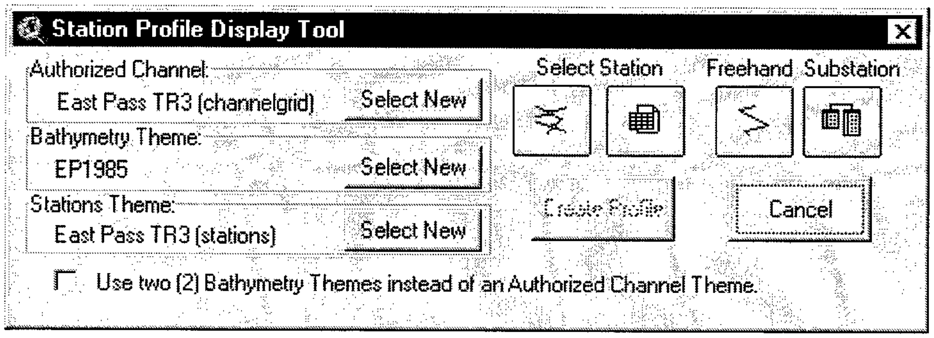


Figure 77. East Pass station profile options dialog

Using the *Select Station* by point icon, click on a station near the channel bend (Figure 78), then click the *Create Profile* button. Choose to accept the default options in the graph formatting dialog. Using the selected station, the *Station Profile Tool* pulls elevation data from the channel template grid and the bathymetric grid — the result is a graph of the cross section at the selected station (Figure 79).

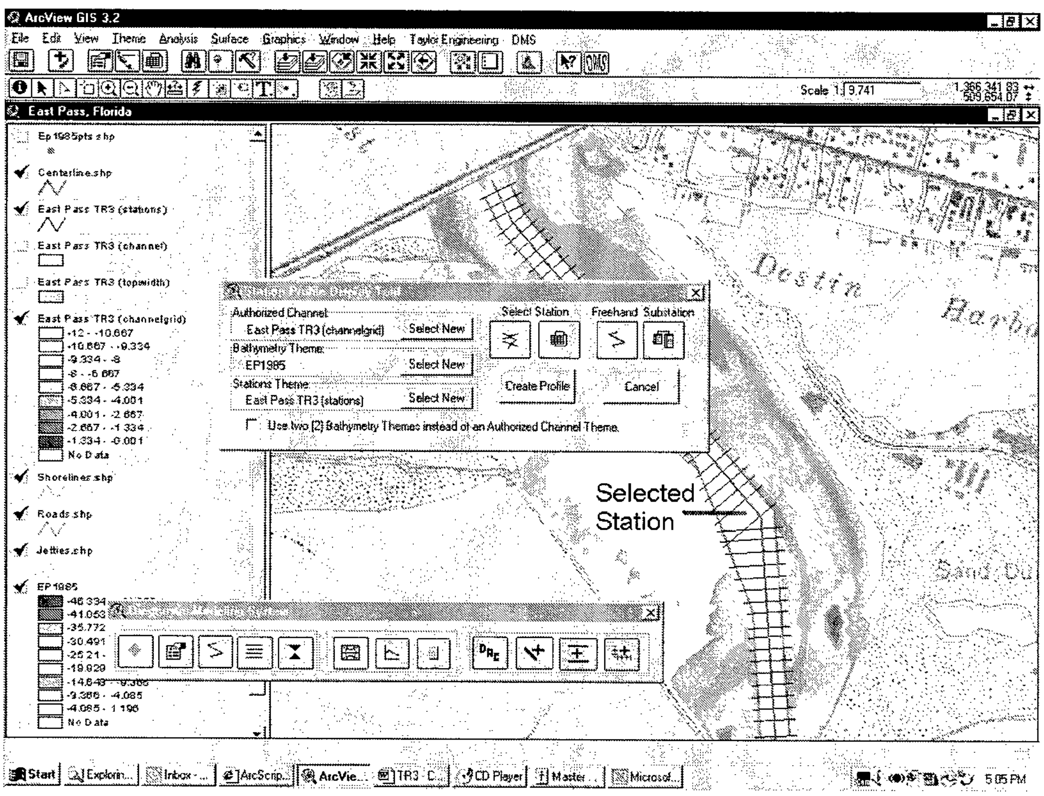


Figure 78. Selected East Pass station near channel bend

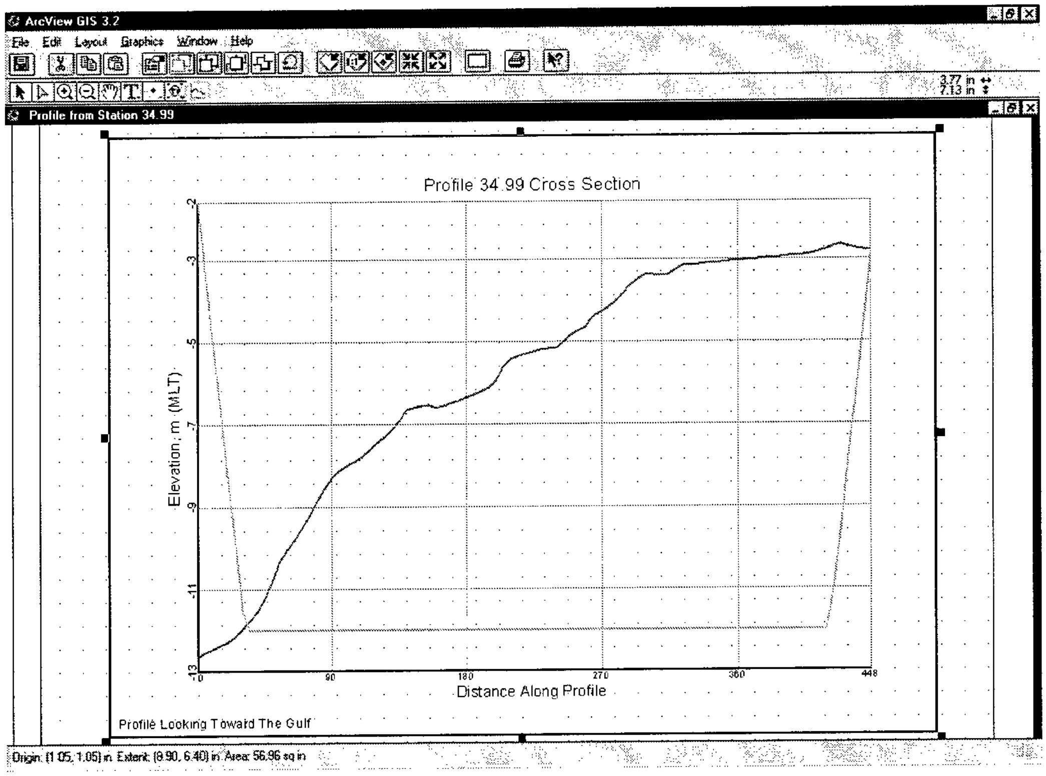


Figure 79. Station profile graph results

Step 5: Volumetric analysis

Start the *Volume Calculator Tool* by clicking the *Volume Calculator* icon on the DMS toolbar. In the screen of the *Volume Calculator Wizard*, set the *Authorized Channel* theme to *East Pass TR3 (channelgrid)*, the *Bathymetry* theme to *EP1985*, and the *Stations* theme to *East Pass TR3 (stations)* (Figure 80). In order to assess overall shoaling problems in the channel, select the *User Drawn Rectangle* in the *Calculation Area* option box. Click the *Click to Draw Rectangle* button to activate the drawing tool in the view. Draw a large rectangle on the view encompassing both grids completely. This will select the entire area that the grids overlap for volume calculations. Select *No* to bypass the overdredge options dialog. The volume calculation process begins immediately.

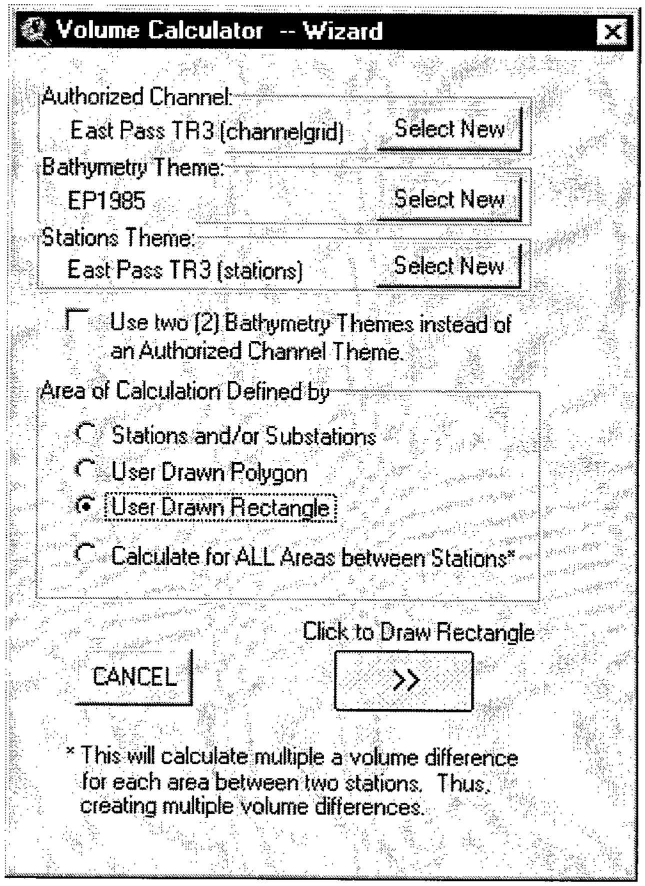


Figure 80. East Pass *Volume Calculator* options dialog

The volume calculation results display in a dialog box (Figure 81). The units are cubic yards by default. Total accretion — a positive value — corresponds to the volume of shoaling above the channel template as represented in the 1985 bathymetry. Total erosion — a negative value — indicates the volume of water below the channel template and above the 1985 bathymetry. The volume difference is the sum of these two values.

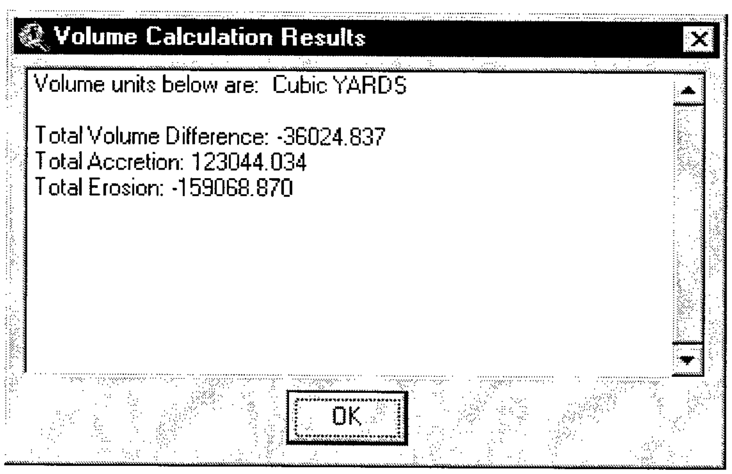


Figure 81. East Pass *Volume Calculator* results dialog

The *Volume Calculator* adds a new grid representing the volume difference between channel template and the 1985 bathymetry (Figure 82). This provides a quick visual indication of areas of shoaling. Red areas are above the channel template (i.e., shoals) and blue areas are below the channel template. This view clearly shows the channel bend shoal as well as a small shoal near the north end of Norriego Point.

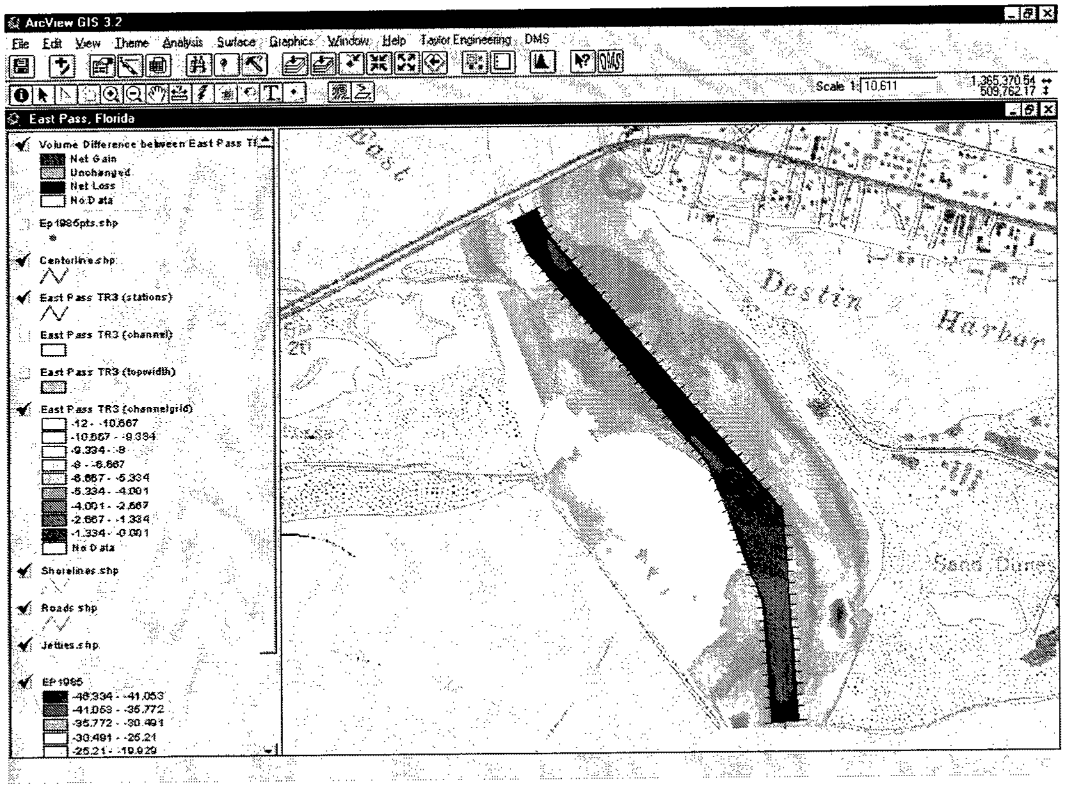


Figure 82. East Pass volume difference grid

Users have a second option to view projectwide volumetric data. In the *Volume Calculator Wizard,* set the *Calculation Area* option to *Calculate for ALL areas between Stations* (Figure 83). This will automatically perform volume calculations between all adjacent stations in the view. A summary table presents the results of this operation within the Data Manager (Figure 84).

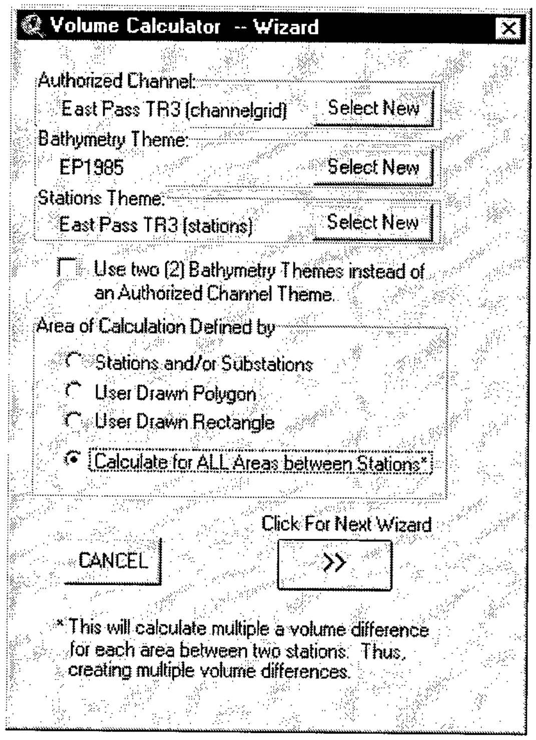
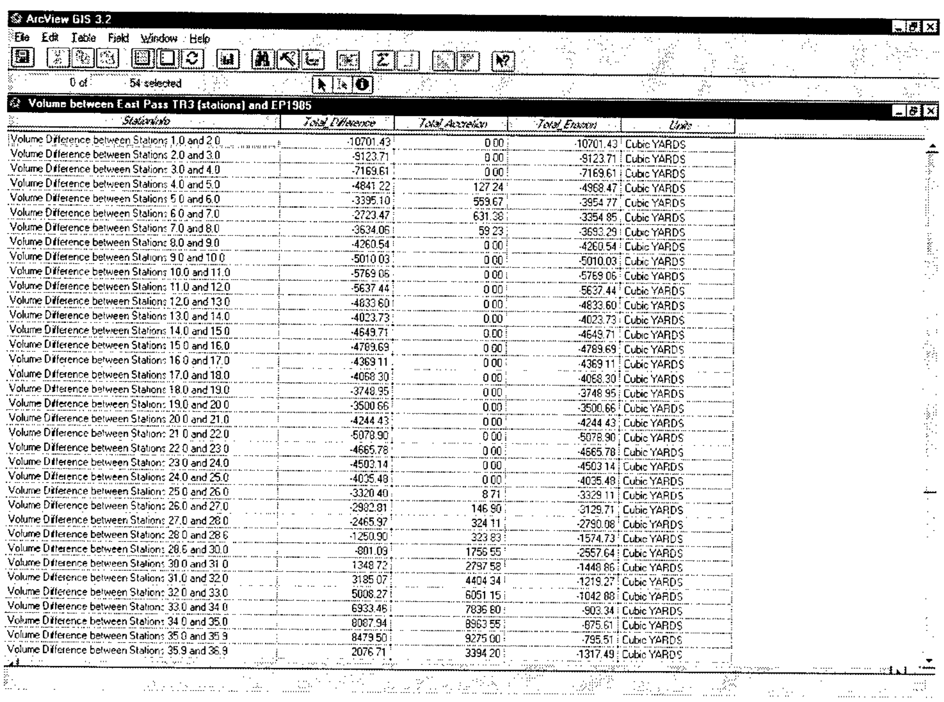


Figure 83. East Pass *Volume Calculator* options dialog with *Calculate for ALL Areas between Stations* selected



ArcView GIS 3.2

0 of 54 selected

Volume between East Pass TR3 (stations) and EP1985

StationInfo	Total_Difference	Total_Accretion	Total_Erosion	Units
Volume Difference between Stations 1.0 and 2.0	-10701.43	0.00	-10701.43	Cubic YARDS
Volume Difference between Stations 2.0 and 3.0	-9123.71	0.00	-9123.71	Cubic YARDS
Volume Difference between Stations 3.0 and 4.0	-7169.61	0.00	-7169.61	Cubic YARDS
Volume Difference between Stations 4.0 and 5.0	-4841.22	127.24	-4968.47	Cubic YARDS
Volume Difference between Stations 5.0 and 6.0	-3395.10	559.67	-3954.77	Cubic YARDS
Volume Difference between Stations 6.0 and 7.0	-2723.47	631.38	-3354.85	Cubic YARDS
Volume Difference between Stations 7.0 and 8.0	-3634.06	59.23	-3693.29	Cubic YARDS
Volume Difference between Stations 8.0 and 9.0	-4260.54	0.00	-4260.54	Cubic YARDS
Volume Difference between Stations 9.0 and 10.0	-5010.03	0.00	-5010.03	Cubic YARDS
Volume Difference between Stations 10.0 and 11.0	-5769.06	0.00	-5769.06	Cubic YARDS
Volume Difference between Stations 11.0 and 12.0	-5637.44	0.00	-5637.44	Cubic YARDS
Volume Difference between Stations 12.0 and 13.0	-4833.60	0.00	-4833.60	Cubic YARDS
Volume Difference between Stations 13.0 and 14.0	-4023.73	0.00	-4023.73	Cubic YARDS
Volume Difference between Stations 14.0 and 15.0	-4649.71	0.00	-4649.71	Cubic YARDS
Volume Difference between Stations 15.0 and 16.0	-4789.69	0.00	-4789.69	Cubic YARDS
Volume Difference between Stations 16.0 and 17.0	-4369.11	0.00	-4369.11	Cubic YARDS
Volume Difference between Stations 17.0 and 18.0	-4068.30	0.00	-4068.30	Cubic YARDS
Volume Difference between Stations 18.0 and 19.0	-3748.95	0.00	-3748.95	Cubic YARDS
Volume Difference between Stations 19.0 and 20.0	-3500.66	0.00	-3500.66	Cubic YARDS
Volume Difference between Stations 20.0 and 21.0	-4244.43	0.00	-4244.43	Cubic YARDS
Volume Difference between Stations 21.0 and 22.0	-5078.90	0.00	-5078.90	Cubic YARDS
Volume Difference between Stations 22.0 and 23.0	-4665.78	0.00	-4665.78	Cubic YARDS
Volume Difference between Stations 23.0 and 24.0	-4503.14	0.00	-4503.14	Cubic YARDS
Volume Difference between Stations 24.0 and 25.0	-4035.48	0.00	-4035.48	Cubic YARDS
Volume Difference between Stations 25.0 and 26.0	-3320.40	8.71	-3329.11	Cubic YARDS
Volume Difference between Stations 26.0 and 27.0	-2982.81	146.90	-3129.71	Cubic YARDS
Volume Difference between Stations 27.0 and 28.0	-2465.97	324.11	-2790.08	Cubic YARDS
Volume Difference between Stations 28.0 and 28.6	-1250.90	323.83	-1574.73	Cubic YARDS
Volume Difference between Stations 28.6 and 30.0	-801.09	1756.55	-2557.64	Cubic YARDS
Volume Difference between Stations 30.0 and 31.0	1348.72	2797.58	-1448.86	Cubic YARDS
Volume Difference between Stations 31.0 and 32.0	3185.07	4404.34	-1219.27	Cubic YARDS
Volume Difference between Stations 32.0 and 33.0	5008.27	6051.15	-1042.88	Cubic YARDS
Volume Difference between Stations 33.0 and 34.0	6933.46	7836.80	-903.34	Cubic YARDS
Volume Difference between Stations 34.0 and 35.0	8087.94	8963.55	-875.61	Cubic YARDS
Volume Difference between Stations 35.0 and 35.9	8479.50	9275.00	-795.51	Cubic YARDS
Volume Difference between Stations 35.9 and 36.9	2076.71	3394.20	-1317.49	Cubic YARDS

Figure 84. East Pass *Volume Calculator* station-by-station results table

Step 6: Historic dredging record reports

The final step in the Data Manager application to East Pass involves review of historic dredging records. Data collection efforts during the preparation of the East Pass Inlet Management Plan help consolidate records of past dredging events in the area. Entering the data in the Dredging Record Center makes these records available within the Data Manager. Because the previous analyses have indicated a probable problem shoaling area near the channel bend, an area report would most likely produce additional corroborating evidence. Click the *Area Report* icon on the DMS toolbar and draw a polygon around the stations of interest (Figure 85).

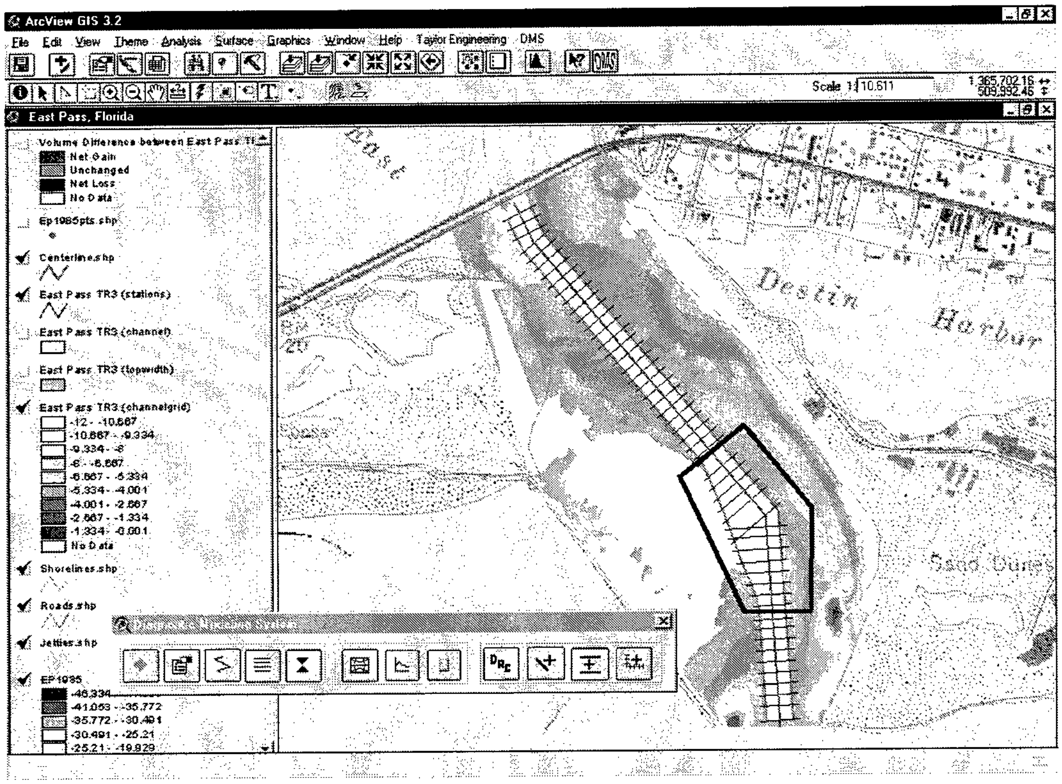


Figure 85. Selected East Pass stations for area report

The *Reporting Tool* queries the DRC database for all records containing the selected stations. A formatted report summarizes the data contained in these records (Figures 86 and 87). This report presents the dredging volume and project costs in graphical format and tabulates records for each dredging event.

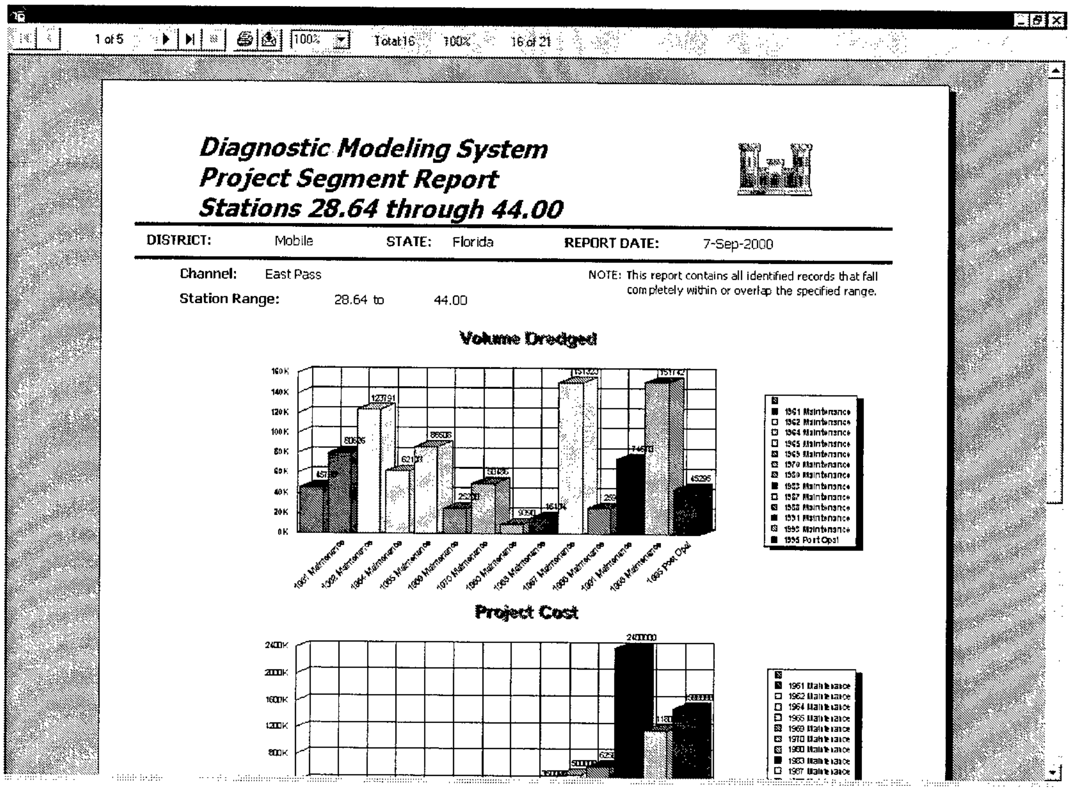


Figure 86. East Pass area report results, page 1

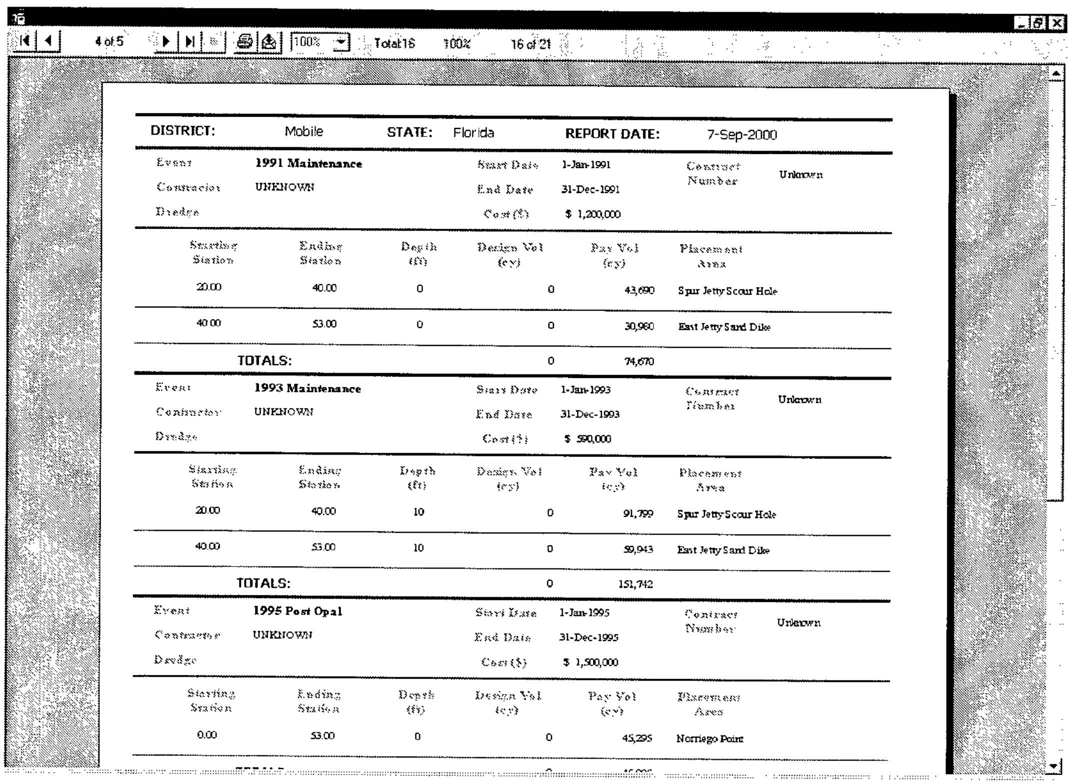


Figure 87. East Pass area report results, page 4

Summary

This application of the Data Manager established a project basemap for East Pass, FL. The *Stationing Tool* helped create a grid of the authorized channel template. Bathymetric data from a 1985 survey was imported into the system. Early in the application process, the channel bend area was identified as a problem shoaling area. The *Import Bathymetry Tool*, the *Station Profile Tool*, the *Volume Calculator*, and the *Reporting Tool* all showed evidence of this phenomenon. Comparisons with other surveys revealed this area to chronically exhibit similar behavior (Gosselin, Craig, and Taylor 1999). The results of this Data Manager application led to further application of DMS concepts in an attempt to identify the underlying causes of the shoaling and possible remediation.

5 Summary and Recommendations

This chapter summarizes the DMS Data Manager, a GIS-based software application developed to organize and analyze data associated with Federal navigation projects. This User's Guide presents the functionality of the custom setup and analysis tools and discusses an application of the software to East Pass, FL.

Summary

The DMS Data Manager, a component of the Diagnostic Modeling System, has been developed to assist Corps personnel design, operate, and maintain the nation's waterways. The Data Manager is a customized extension to the commercially available GIS software package ArcView by ESRI. The tools developed for the Data Manager allow users to create and centralize extensive project-related databases and provide a user-friendly GUI with which to interact with the data. Four tools help with project setup and four tools provide data analysis options. Hydrographic survey data are interpolated on to standard grids for later cross-sectional and volumetric analysis. With these tools, the objective is met to provide a simple, standardized way for users to organize project data and apply independent analysis methods and those developed in the DMS.

This report discusses the four project setup tools, namely:

a. *Getting Started* screen.

b. *Setup Wizard.*

c. *Stationing Tool.*

d. *Import Bathymetry Tool.*

The four data analysis tools are:

a. *Station Profile Tool.*

b. *Volume Calculator.*

c. *Dredging Record Center.*

d. *Reporting Tool.*

The example application at East Pass, FL documented the setup and analysis process that may be incorporated at other Federal navigation projects. This application revealed a problem shoaling area at the channel bend of the East Pass Federal Navigation Channel. The *Import Bathymetry Tool*, the *Station Profile Tool*, the *Volume Calculator Tool*, and the *Reporting Tool* in conjunction with the Dredging Record Center provided confirmation of the problem shoaling area.

Recommendations

This report has shown the utility of the DMS Data Manager for organizing Federal navigation project data. The DMS work unit has identified several areas of improvement for the Data Manager. These areas include:

a. Expanding the types and formats of data that may be included in a Data Manager project.

b. Creating import tools for other software packages to facilitate data sharing with other programs.

c. Developing an interface with the DMS-Manual and DMS-Analytical Toolbox to provide proper definition of shoals.

d. Developing time frames associated with shoaling to aid in scheduling maintenance dredging.

e. Providing feedback with the DMS-Analytical Toolbox to aid in validation of the analytical tools.

Such work, as well as recommendations made by users, will be conducted and incorporated in the Data Manager.

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14. ABSTRACT

This report documents the development, functionality, and application of the Diagnostic Modeling System (DMS) Data Manager, a Geographic Information System (GIS)-based software package to organize and examine dredging-related data.

The DMS gives a rapid evaluation or diagnosis of a problem shoaling area and provides guidance for determining possible solutions. The economic lever underlying the DMS concept is that a low-level analysis, possibly supplemented by a modest numerical modeling effort, can yield substantial cost savings without interrupting ongoing O&M activities and schedules. That is, the DMS is intended to provide feasible alternatives for reducing O&M costs within the dreging cycle of the subject project. The application time and effort in applying the DMS are proportional to the maintenance time of the project.

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Dredging record center
Dredging reports
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